6.4 TRAFFIC SURVEY METHODOLOGY AND ANALYSIS

A comprehensive methodology has been evolved to carry out the work. A stepwise methodology is presented in Figure 87.
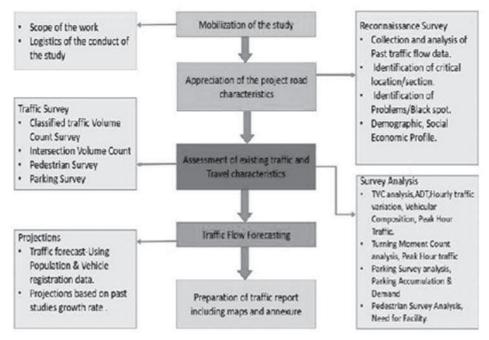

Figure 87: Traffic Survey Methodology

6.4.1 TRAFFIC SURVEY AND SCHEDULE

Classified Traffic Volume Counts (CVC's) have been conducted using manual count by trained enumerators method at different locations. The survey locations are depicted in Figure 91 Traffic survey stations have been selected by the Consultant based on understanding of the road network as well as consideration of the following aspects:

- To represent critical traffic section
- To be a major influence area
- To be located at a level with good visibility

Based on the detailed reconnaissance of the project area, major traffic generators, major intersections and travel patterns, Classified Volume Count (CVC) locations and other surveys were identified at different locations. 3-Day Classified Volume Count (CVC's) and 2- day Origin and Destination (O-D) Survey at a total of 9 locations (CVC at 7 and O-D at 2 locations) in Nagaon Planning Area to understand traffic intensity in the Master Plan Area.

Brief description and analysis of each of the above surveys are presented in the following sections. The schedule of all traffic surveys is presented in Table 97

Table 97 Traffic Survey Locations and Schedule

Sr. No	Type of Survey	Location	Date
1	Classified Traffic Volume Count	Haiborgaon Bazar Road	24/12/20, 25/12/20
		ADP Road	24/12/20, 25/12/20
		SH-47 (Dhing Road)	24/12/20, 25/12/20
		SH-3 (Lathabori- Haiborgaon Bazar)	24/12/20, 25/12/20
		Old NH (Nagaon Morigaon Road)	24/12/20, 25/12/20
		SH 3 (Laokhowa Road)	24/12/20, 25/12/20
		Nagaon Lumbding Road	24/12/20, 25/12/20
		GNB Road	24/12/20, 25/12/20
2	Origin-Destination Survey	SH-47, SH-3 and SH-18	21/12/20, 22/12/20
		Old NH	23/12/20
		Nagaon-Lumding Road and AT road	21/12/20, 22/12/20
3	Turning Movement Count (Junction Analysis)	Dhing Gate Junction	21/12/20, 22/12/20
		Laokhowa Road- Hiborgaon Tiniali	21/12/20, 22/12/20
		Old NH-Hiborgaon Junction	21/12/20, 22/12/20
		Natun Bazar Chariali	21/12/20, 22/12/20
		Dekapatty Chariali	21/12/20, 22/12/20
		Civil Gate Junction	21/12/20, 22/12/20
4	Parking Survey	Barabazar	04/03/21
		DC court	04/03/21
		Haiborgaon Bazar	04/03/21
		Stadium Market	04/03/21
5	Pedestrian Survey	Barabazar	04/03/21
		DC court	04/03/21
		Haiborgaon Bazar	04/03/21
		Stadium Market	04/03/21
6	Speed Delay Survey	Haiborgaon Bazar road	05/03/21
		Dhing Road	05/03/21
		Bara Bazar Road	05/03/21
		GNB Road	05/03/21

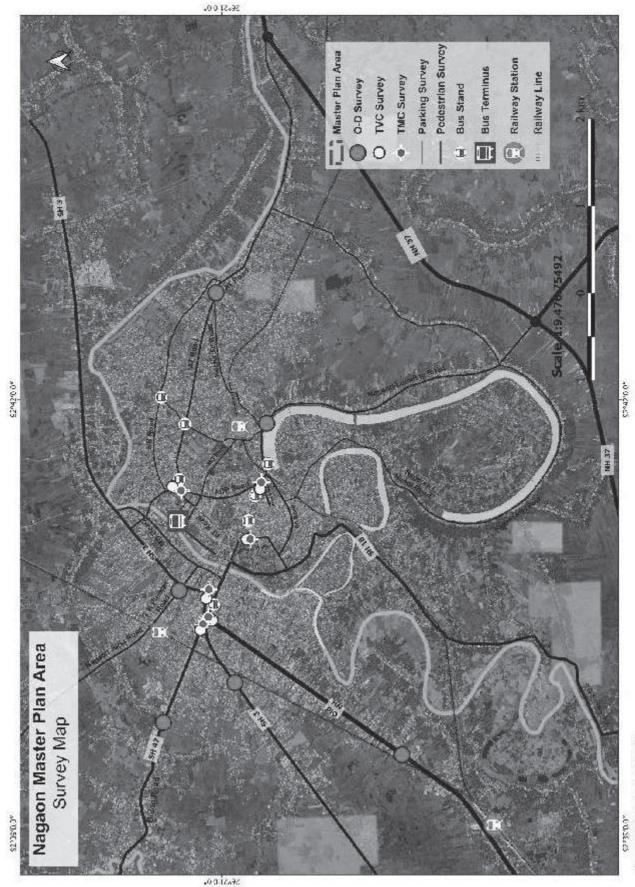*(Source: Compiled by Consultants)*

Figure 86: Survey map of NMPA

6.5 TRAFFIC INTENSITY

The various vehicle types having different sizes and characteristics were converted into equivalent passenger car units. The selected survey stretches comprise both urban and rural areas. Hence PCU values were adopted from IRC 64-1990 for rural areas and IRC-106-1990 for urban areas. The PCU values used are presented in Table 98.

Table 98 Vehicle classification system and PCU factors adopted for study

Sr. No	Vehicle type	PCU factor for Urban	PCU factor for Rural
1	Car/Jeep/Van	1	1
2	Taxi	1	1
3	2-wheeler	0.75	0.5
4	3-wheeler	1.2	1
5	Minibus	1.4	1.5
6	Standard Bus	2.2	3
7	3-wheeler (Goods)	1.2	1
8	LCV	1.4	1.5
9	2 Axle	2.2	3
10	2 Axle	2.2	3
11	MAV	4	4.5
12	Tractor	1.4	1.5
13	Tractor with Trailor	4	4.5
14	Cycle	0.5	0.5
15	Other (JCB/HCM)	4	4.5

AT Road, ADP road, Dhing road, Sidha Morigaon road, Laokhaw road, nagaon-Lumding road and GNB road have been considered as urban roads. The photographs of survey locations are as shown in Figures below.

Survey at Natun Bazaar Chariali

Survey at Morikolong

Survey at Decapatty Chairali

Survey Haiborgaon Chairali

Survey at Haiborgaon Tiniali

Survey at Dhing gate

Survey at Bara Bazar

Road section Measurement

6.5.1 HAIBORGAON BAZAR ROAD

Annual average daily traffic is 10503 PCU in this road section. Passenger vehicles like car/taxi/utility vehicles, two wheelers predominate the traffic stream. Non-Motorised vehicles were observed in less volume. Some LCV were present while heavy goods vehicles like 2-Axle, 3 Axle, MAV were not much observed. ADT and AADT by vehicle type is presented in Table 99.

Table 99 Average Daily Traffic & Annual Average Daily Traffic on Haiborgaon Bazar Road

Vehicle Types	ADT	AADT
Car/Jeep/Van	2635	2683
2-wheeler	4372	4632
3-wheeler	1492	1562
Minibus	240	310
Standard Bus	98	124
3-wheeler (Goods)	708	754
LCV	270	318
2 Axle	0	0
3 Axle	0	0
MAV	0	0
Tractor	0	0
Tractor with Trailor	0	0
Cycle	777	830
Other (JCB/HCM)	0	0
Total (Nos)	10592	11213
Total (PCU)	9872	10503

(Source: Compiled by Consultant)

6.5.1.1 Directional Split

The traffic data was analyzed to establish the directional distribution of traffic. The directional distribution of traffic at the TVC location is given in Table 100.

Table 100 Directional Distribution of Traffic on Haiborgaon Bazar Road

TVC Location	Directional distribution in vehicle numbers	Directional distribution in PCU
	SH-18 – MD road junc. to Haiborgaon junc. : Haoborgaon junc. to SH-18-MD road	SH-18 – MD road junc. to Haiborgaon junc. : Haoborgaon junc. to SH-18-MD road
Haiborgaon Bazar road	54:46	53:47

(Source: Compiled by Consultant)

6.5.1.2 Vehicle Composition

Composition of traffic at the midblock location is presented in Figure 89. Road section is occupied by mainly two-wheeler and car/utility vehicles which are 41% and 25% of total traffic. Thus, commuters are using their personal vehicles to a large extent for daily routine. Public transport (bus) was observed to be less at 1% of traffic stream. Goods 3-wheeled vehicles (LCV) comprised 7% of traffic.
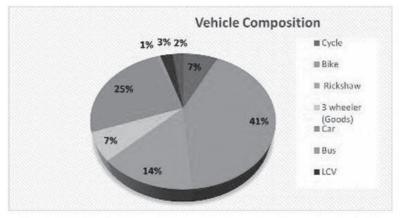

Figure 89: Composition of Traffic on Haiborgaon Bazar Road   Source: Compiled by Consultant)

6.5.1.3 Hourly Variation of Traffic

The hourly distribution of traffic to understand hourly variation and peak hour traffic characteristics at AT Main Road as shown in Figure 90.
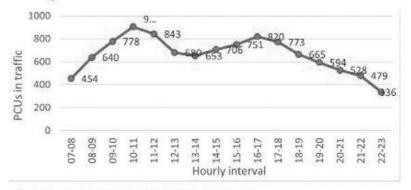

Figure 90: Hourly Variation of Traffic at Haiborgaon bazar Road

6.5.1.4 Peak Hour Traffic

Peak hour was found to be from 10:00 to 11:00 HRS. Total peak hour traffic is 905 in PCU which is 8.5% of ADT. The peak hour and peak hour traffic at the midblock location is presented in Table 101.

Table 101 Peak hour traffic on Haiborgaon Bazar road

PCU/hr	Peak Hours	Peak Hour Factor
905	10:00 to 11:00	8.5

6.5.2 ADP ROAD

Annual average daily traffic is 10040 PCU in this road section. Passenger vehicles like car/taxi/utility vehicles, two wheelers predominate the traffic stream. Non-Motorised vehicles were observed in less volume. Some LCV were present while heavy goods vehicles like 2-Axle, 3 Axle, MAV were not much observed. ADT and AADT by vehicle type is presented in Table 102.

Table 102 Average Daily Traffic & Annual Average Daily Traffic on ADP road

Vehicle Types	ADT	AADT
Car/Jeep/Van	2558	2613
2-wheeler	4245	4357
3-wheeler	1456	1499
Minibus	250	297
Standard Bus	95	93
3-wheeler (Goods)	774	769
LCV	256	297
2 Axle	0	0
3 Axle	0	0
MAV	0	0
Tractor	0	0
Tractor with Trailor	0	0
Cycle	770	802
Other (JCB/HCM)	0	0
Total (Nos)	10404	10727
Total (PCU)	9720	10040

6.5.2.1 Directional Split

The traffic data was analyzed to establish the directional distribution of traffic. The directional distribution of traffic at the TVC location is given in Table 103.

Table 103 Directional Distribution of Traffic on ADP Road

TVC Location	Directional distribution in vehicle numbers	Directional distribution in PCU
	Natun Bazar chariali to Nagaon-Lumbding road: Nagaon-Lumbding road to Natun Bazar Chariali	Natun Bazar chariali to Nagaon-Lumbding road: Nagaon-Lumbding road to Natun Bazar Chariali
ADP Road	53:47	52:48

6.5.2.2 Vehicle Composition

Composition of traffic at the midblock location is presented in Figure 91. Road section is occupied by mainly two-wheeler and car/taxi/utility vehicles which are 41% and 25% of total traffic. Thus, commuters are using their personal vehicles to a large extent for daily routine. Public transport (bus) was observed to be less at 1% of traffic stream. Goods 3-wheeled vehicles comprised 7% of traffic, whereas LCV are 3% of total.
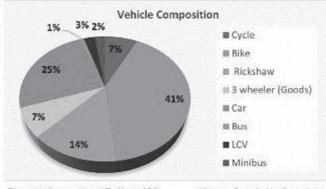

Figure 91: Composition of Traffic on ADP   (Source: Compiled by Consultant)

6.5.2.3 Hourly Variation of Traffic

The hourly distribution of traffic to understand hourly variation and peak hour traffic characteristics at ADP Main Road as shown in Figure 92.

Figure 92: Hourly traffic variation of ADP road

6.5.2.4 Peak Hour Traffic

Peak hour was found to be from 10:00 to 11:00 HRS. Total peak hour traffic is 836 in PCU which is 8.03% of ADT. The peak hour and peak hour traffic at the midblock location is presented in Table 104.

Table 104 Peak hour traffic on SH-47 Road

PCU/hr	Peak Hours	Peak Hour Factor
836	10:00 to 11:00	8.03

(Source: Compiled by Consultant)

6.5.3 SH- 47 (DHING ROAD)

Annual average daily traffic is 15681 PCU in this road section. Passenger vehicles like car/utility vehicles, two wheelers predominate the traffic stream. Non-Motorised vehicles were observed in less volume. Some LCV were present while heavy goods vehicles like 2-Axle, 3 Axle, MAV were not much observed. ADT and AADT by vehicle type is presented in Table 105.

Table 105 Average Daily Traffic & Annual Average DailyTraffic on SH-47 road

Vehicle Types	ADT	AADT
Car/Jeep/Van	1890	1957
2-wheeler	4465	4632
3-wheeler	2650	2853
Minibus	780	793
Standard Bus	80	93
3-wheeler (Goods)	2738	2876
LCV	1074	1175
2 Axle	0	0
3 Axle	0	0
MAV	0	0
Tractor	0	0
Tractor with Trailor	0	0
Cycle	797	830
Other (JCB/HCM)	0	0
Total (Nos)	14474	15209
Total (PCU)	14874	15681

6.5.3.1 Directional Split

The traffic data was analyzed to establish the directional distribution of traffic. The directional distribution of traffic at the TVC location is given in Table 106.

Table 106 Directional Distribution of Traffic on SH-47 Dhing Road

TVC Location	Directional distribution in vehicle numbers	Directional distribution in PCU
	Dhing gate to Dhing road flyover: Dhing road flyover to Dhing gate	Dhing gate to Dhing road flyover: Dhing road flyover to Dhing gate
Dhing Road	54:46	54:46

6.5.3.2 Vehicle Composition

Composition of traffic at the midblock location is presented in Figure 93. Road section is occupied by mainly two-wheeler and car/taxi/utility vehicles which are 31% and 13% of total traffic. Thus, commuters are using their personal vehicles to a large extent for daily routine. Public transport (bus) was observed to be less at 1% of traffic stream. Goods 3-wheeled vehicles comprised 19% of traffic, whereas LCV are 7% of total.
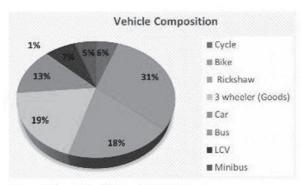

Figure 93: Composition of Traffic on SH-47 Dhing Road

6.5.3.3 Peak Hour Traffic

Peak hour was found to be from 10:00 to 11:00 HRS. Total peak hour traffic is 1228 in PCU which is 8.48% of ADT. The peak hour and peak hour traffic at the midblock location is presented in Table 107.

Table 107 Peak hour traffic on SH 3 Road

PCU/hr	Peak Hours	Peak Hour Factor
1228	10:00 to 11:00	8.48

6.5.3.4 Hourly Variation of Traffic

The hourly distribution of traffic to understand hourly variation and peak hour traffic characteristics at Dhing Road as shown in Figure 94.

Figure 94: Hourly traffic variation of SH-3 Dhing gate

6.5.4 SH- 3 (LATHABORI – HAIBORGAON BAZAR ROAD)

Annual average daily traffic is 9598 PCU in this road section. Passenger vehicles like car/taxi/utility vehicles, two wheelers predominate the traffic stream. Non-Motorised vehicles were observed in less volume. Goods 3-wheeler vehicles were present in good number while heavy goods vehicles like 3 Axle, MAV were not much observed. ADT and AADT by vehicle type is presented in Table 108.

Table 108 Average Daily Traffic & Annual Average DailyTraffic on SH 3 road

Vehicle Types	ADT	AADT
Car/Jeep/Van	856	967
2-wheeler	3198	3284
3-wheeler	3233	3487
Minibus	75	84
Standard Bus	40	355
3-wheeler (Goods)	771	784
LCV	588	597
2 Axle	0	0
3 Axle	0	0
MAV	0	0
Tractor	0	0
Tractor with Trailor	0	0
Cycle	837	913
Other (JCB/HCM)	0	0
Total (Nos)	9598	10387
Total (PCU)	9494	10746

6.5.4.1 Directional Split

The traffic data was analyzed to establish the directional distribution of traffic. The directional distribution of traffic at the TVC location is given in Table 109.

Table 109 Directional Distribution of Traffic on SH-3 (Lathabori to Haibor Bazar Road)

TVC Location	Directional distribution in vehicle numbers	Directional distribution in PCU
	Lathabori to Haibor bazar road: Haibor Bazar road to Lathabori	Lathabori to Haibor bazar road: Haibor Bazar road to Lathabori
SH-3 (Lathabori to Haibor Bazar road)	49:51	48:52

(Source: Compiled by Consultant)

6.5.4.2 Vehicle Composition

Composition of traffic at the midblock location is presented in Figure 95. Road section is occupied by mainly two-wheeler and car/taxi/utility vehicles which are 33% and 9% of total traffic. Thus, commuters are using their personal vehicles to a large extent for daily routine. Public transport (bus) was observed to be less at 0.1% of traffic stream. 3-wheeled vehicles comprised 34% of traffic, whereas trucks are 8% of total.
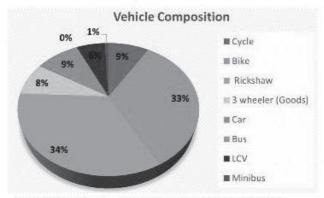

Figure 95: Composition of Traffic on SH-3 (Lathabori to Haibor bazar Road)

(Source: Compiled by Consultant)

6.5.4.3 Hourly Variation of Traffic

The hourly distribution of traffic to understand hourly variation and peak hour traffic characteristics at SH 3 Lathabori -Old AT Road as shown in Figure 96.

Figure 96: Hourly traffic variation of SH-3

6.5.4.4 Peak Hour Traffic

Peak hour was found to be from 10:00 to 11:00 HRS. Total peak hour traffic is 801 in PCU which is 8.3% of ADT. The peak hour and peak hour traffic at the midblock location is presented in Table 110.

Table 110 Peak hour traffic on SH-3 Road

PCU/hr	Peak Hours	Peak Hour Factor
801	10:00 to 11:00	8.3

6.5.5 OLD NH (NAGAON MORIGAON ROAD)

Annual average daily traffic is 9971 PCU in this road section. Passenger vehicles like car/taxi/utility vehicles, two wheelers predominate the traffic stream. Non-Motorised vehicles were observed in less volume. Goods 3-wheeled vehicles were present in good number while heavy goods vehicles like 3 Axle, MAV were not much observed. ADT and AADT by vehicle type is presented in Table 111.

Table 111 Average Daily Traffic & Annual Average Daily Traffic on Old NH road

Vehicle Types	ADT	AADT
Car/Jeep/Van	886	907
2-wheeler	3663	3714
3-wheeler	3213	3231
Minibus	37	43
Standard Bus	7	5
3-wheeler (Goods)	788	759
LCV	425	413
2 Axle	0	0
3 Axle	0	0
MAV	0	0
Tractor	0	0
Tractor with Trailor	0	0
Cycle	952	978
Other (JCB/HCM)	0	0
Total (Nos)	9971	10050
Total (PCU)	9573	9619

(Source: Compiled by Consultant)

6.5.5.1 Directional Split

The traffic data was analyzed to establish the directional distribution of traffic. The directional distribution of traffic at the TVC location is given in Table 112.

Table 112 Directional Distribution of Traffic on Old NH Road

TVC Location	Directional distribution in vehicle numbers	Directional distribution in PCUW
	Haiborgaon Teniali to Babejia : Babejia to Haiborgaon Teniali	Haiborgaon Teniali to Babejia : Babejia to Haiborgaon Teniali
Old NH Road	47:53	48:52

6.5.5.2 Vehicle Composition

Composition of traffic at the midblock location is presented in Figure 97. Road section is occupied by mainly two-wheeler and car/utility vehicles which are 37% and 9% of total traffic. Thus, commuters are using their personal vehicles to a large extent for

daily routine. Public transport (bus) was observed to be less at 0.1% of traffic stream. Goods 3-wheeler vehicles comprised 8% of traffic, whereas LCV are 4% of total.
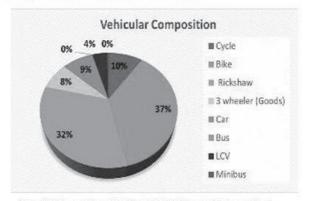

Figure 97: Composition of Traffic on Old NH (Nagaon Morigaon Road)

(Source: Compiled by Consultant)

6.5.5.3 Hourly Variation of Traffic

The hourly distribution of traffic to understand hourly variation and peak hour traffic characteristics at Old NH Road as shown in Figure 98.
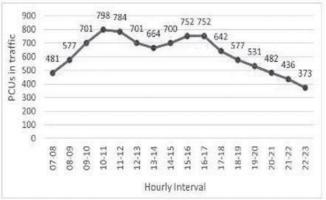

Figure 98: Hourly traffic variation of Old NH

(Source: Compiled by Consultant)

6.5.5.4 Peak Hour Traffic

Peak hour was found to be from 10:00 to 11:00 HRS. Total peak hour traffic is 798 in PCU which is 8.0% of ADT. The peak hour and peak hour traffic at the midblock location is presented in Table 113.

Table 113 Peak hour traffic on Old NH Road

PCU/hr	Peak Hours	Peak Hour Factor
798	10:00 to 11:00	8.0

(Source: Compiled by Consultant)

6.5.6 SH 3 (LAOKHOWA ROAD)

Annual average daily traffic is 17238 PCU in this road section. Passenger vehicles like car/taxi/utility vehicles, two wheelers predominate the traffic stream. Non-Motorised vehicles were observed in medium volume. LCV vehicles were present in good number while heavy goods vehicles like 3 Axle, MAV were observed here due to outer road links with other districts. ADT and AADT by vehicle type is presented in Table 114.

Table 114 Average Daily Traffic & Annual Average Daily Traffic on SH 3 road

Vehicle Types	ADT	AADT
Car/Jeep/Van	4095	4102
2-wheeler	5713	5893
3-wheeler	2779	2813
Minibus	742	805
Standard Bus	125	103
3-wheeler (Goods)	2263	2153
LCV	472	498
2 Axle	0	0
3 Axle	0	0
MAV	0	0
Tractor	0	0
Tractor with Trailor	0	0
Cycle	1049	975
Other (JCB/HCM)	0	0
Total (Nos)	17238	17342
Total (PCU)	16929	17019

(Source: Compiled by Consultant)

6.5.6.1 Directional Split

The traffic data was analyzed to establish the directional distribution of traffic. The directional distribution of traffic at the TVC location is given in Table 115.

Table 115 Directional Distribution of Traffic on SH-3 (Laokhowa Road)

TVC Location	Directional distribution in vehicle numbers	Directional distribution in PCU
	MD road to Palasoni road: Palasoni to MD road	MD road to Palasoni road: Palasoni to MD road
SH-3 (Laokhowa Road)	52:48	53:47

(Source: Compiled by Consultant)

6.5.6.2 Vehicle Composition

Composition of traffic at the midblock location is presented in Figure 99. Road section is occupied by mainly two-wheeler and car/utility vehicles which are 36% and 24% of total traffic. Thus, commuters are using their personal vehicles to a large extent for daily routine. Public transport (bus) was observed to be less at 1% of traffic stream. LCV vehicles comprised 3% of traffic.
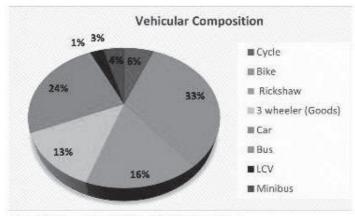
Figure 99: Composition of Traffic on SH-3 Laokhowa Road

(Source: Compiled by Consultant)

6.5.6.3 Hourly Variation of Traffic

The hourly distribution of traffic to understand hourly variation and peak hour traffic characteristics at Laokhowa Road as shown in Figure 100.
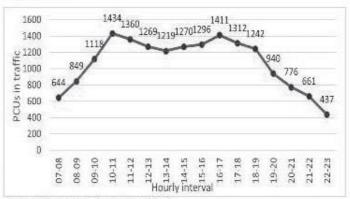

Figure 100: Hourly traffic variation of SH-3

6.5.6.4 Peak Hour Traffic

Peak hour was found to be from 10:00 to 11:00 HRS. Total peak hour traffic is 434 in PCU which is 8.31% of ADT. The peak hour and peak hour traffic at the midblock location is presented in Table 116.

Table 116 Peak hour traffic on SH 3 Laokhowa Road

PCU/hr	Peak Hours	Peak Hour Factor
434	10:00 to 11:00	8.31

(Source: Compiled by Consultant)

6.5.7 NAGAON LUMBDING

Annual average daily traffic is 14126 PCU in this road section. Passenger vehicles like car/taxi/utility vehicles, two wheelers predominate the traffic stream. Non-Motorised vehicles were observed in medium volume. LCV vehicles were present in good number while heavy goods vehicles like 3 Axle, MAV were observed here due to outer road links with other districts. ADT and AADT by vehicle type are presented in Table 117.

Table 117 Average Daily Traffic & Annual Average Daily Traffic on Nagaon-Lumbding road

Vehicle Types	ADT	AADT
Car/Jeep/Van	3438	3422
2-wheeler	4554	4453
3-wheeler	2280	2315
Minibus	570	593
Standard Bus	339	410
3-wheeler (Goods)	657	624
LCV	521	510
2 Axle	0	0
3 Axle	0	0
MAV	0	0
Tractor	0	0
Tractor with Trailor	0	0
Cycle	1809	1799
Other (JCB/HCM)	0	0
Total (Nos)	14168	14126
Total (PCU)	13556	13634

(Source: Compiled by Consultant)

6.5.7.1 Directional Split

The traffic data was analyzed to establish the directional distribution of traffic. The directional distribution of traffic at the TVC location is given in Table 118

Table 118 Directional Distribution of Traffic on Nagaon Lumbding Road

TVC Location	Directional distribution in vehicle numbers	Directional distribution in PCU
	Morikolong to Borghat point: Borghat point to Morikolong	Morikolong to Borghat point: Borghat point to Morikolong
Nagaon Lumbding	52:48	53:47

(Source: Compiled by Consultant)

6.5.7.2 Vehicle Composition

Composition of traffic at the midblock location is presented in Figure 101. Road section is occupied by mainly two-wheeler and car/utility vehicles which are 32% and 24% of total traffic. Thus, commuters are using their personal vehicles to a large extent for daily routine. Public transport (bus) was observed to be less at 2% of traffic stream. LCV vehicles comprised 4% of traffic.
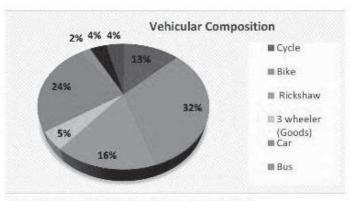
Figure 101: Composition of Traffic on Nagaon – Lumbding Road

(Source: Compiled by Consultant)

6.5.7.3 Hourly Variation of Traffic

The hourly distribution of traffic to understand hourly variation and peak hour traffic characteristics at Nagaon Lumbding Road as shown in Figure 102.
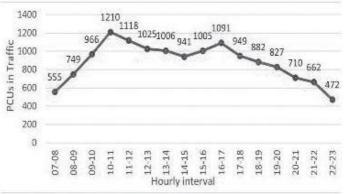

Figure 102: hourly variation of Nagaon-Lumbding road

(Source: Compiled by Consultant)

6.5.7.4 Peak Hour Traffic

Peak hour was found to be from 10:00 to 11:00 HRS. Total peak hour traffic is 1210 in PCU which is 8.54% of ADT. The peak hour and peak hour traffic at the midblock location is presented in Table 119.

Table 119 Peak hour traffic on Nagaon Lumbding Road

PCU/hr	Peak Hours	Peak Hour Factor
1210	10:00 to 11:00	8.54

(Source: Compiled by Consultant)

6.5.8 GNB ROAD

Annual average daily traffic is 12949 PCU in this road section. Passenger vehicles like car/taxi/utility vehicles, two wheelers predominate the traffic stream. Non-Motorised vehicles were observed in medium volume. LCV vehicles were present in good number while heavy goods vehicles like 3 Axle, MAV were observed here due to outer road links with other districts. ADT and AADT by vehicle type is presented in Table 120.

Table 120 Average Daily Traffic & Annual Average Daily Traffic on GNB road

Vehicle Types	ADT	AADT
Car/Jeep/Van	4470	4632
2-wheeler	4452	4632
3-wheeler	1484	1507
Minibus	242	269
Standard Bus	100	102
3-wheeler (Goods)	720	723
LCV	271	286
2 Axle	0	0
3 Axle	0	0
MAV	0	0
Tractor	0	0
Tractor with Trailor	0	0
Cycle	714	798
Other (JCB/HCM)	0	0
Total (Nos)	12453	12949
Total (PCU)	11749	12182

6.5.8.1 Directional Split

The traffic data was analyzed to establish the directional distribution of traffic. The directional distribution of traffic at the TVC location is given in Table 121.

Table 121 Directional Distribution of Traffic on GNB Road

TVC Location	Directional distribution in vehicle numbers	Directional distribution in PCU
	Decapatty to Bara Bazar: Bara Bazar to Decapatty	Decapatty to Bara Bazar: Bara Bazar to Decapatty
GNB Road	52:48	53:47

(Source: Compiled by Consultant)

6.5.8.2 Vehicle Composition

Composition of traffic at the midblock location is presented in Figure 103. Road section is occupied by mainly two-wheeler and car/taxi/utility vehicles which are 36% and 36% of total traffic. Thus, commuters are using their personal vehicles to a large extent for daily routine. Public transport (bus) was observed to be less at 1% of traffic stream. LCV vehicles comprised 2% of traffic.
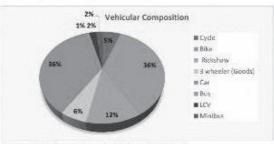

Figure 103: Composition of Traffic on GNB Road

6.5.8.3 Hourly Variation of Traffic

The hourly distribution of traffic to understand hourly variation and peak hour traffic characteristics at GNB Road as shown in Figure 104.
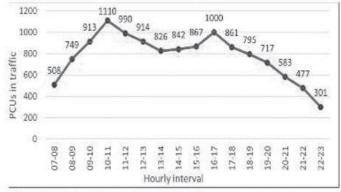

Figure 104: Hourly traffic composition of GNB road

6.5.8.4 Peak Hour Traffic

Peak hour was found to be from 10:00 to 11:00 HRS. Total peak hour traffic is 1110 in PCU which is 8.91% of ADT. The peak hour and peak hour traffic at the midblock location is presented in Table 122.

Table 122 Peak hour traffic on GNB Road

PCU/hr	Peak Hours	Peak Hour Factor
1110	10:00 to 11:00	8.91

6.5.9 TRAFFIC CONGESTION

Traffic congestion takes place when traffic spills over than the design capacity of any road. The severity of traffic congestion can be identified using average daily traffic count and volume by capacity ratio method. Ratio greater than 1 indicates sever congestion, 0.75 to 1 indicates heavy congestion,0.50 to 0.75 indicates moderate congestion and less than 0.5 considered as low congestion.
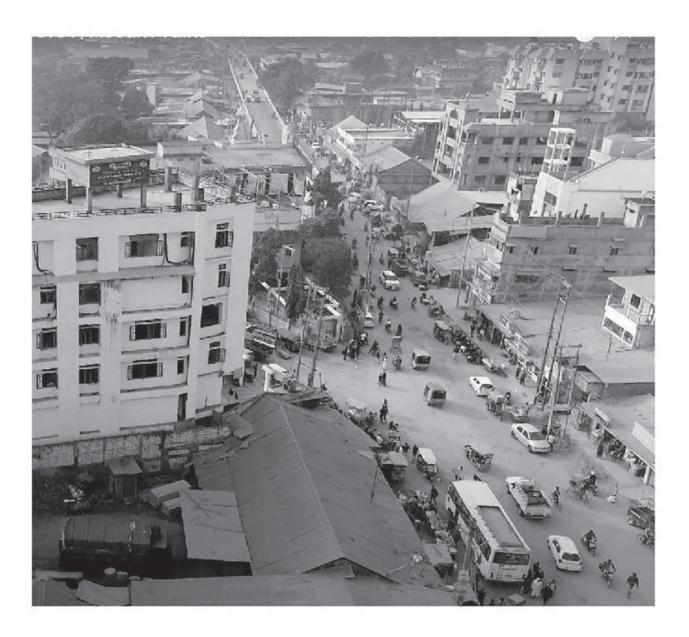
Form the analysis mentioned in above Table 123 it can be inferred that the patches of Nagaon-Lumbding road, SH-47 (Dhing road) and SH-3 (Laokhowa) are congested with heavy traffic. Another major road i.e., Nagaon-Lumbding road is moderately congested and remaining five roads are less congested.
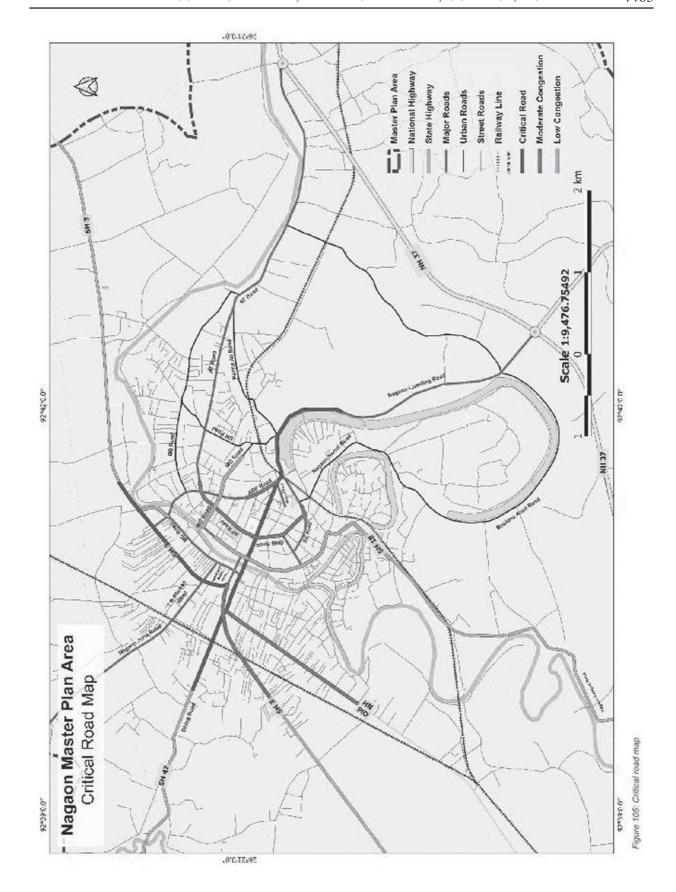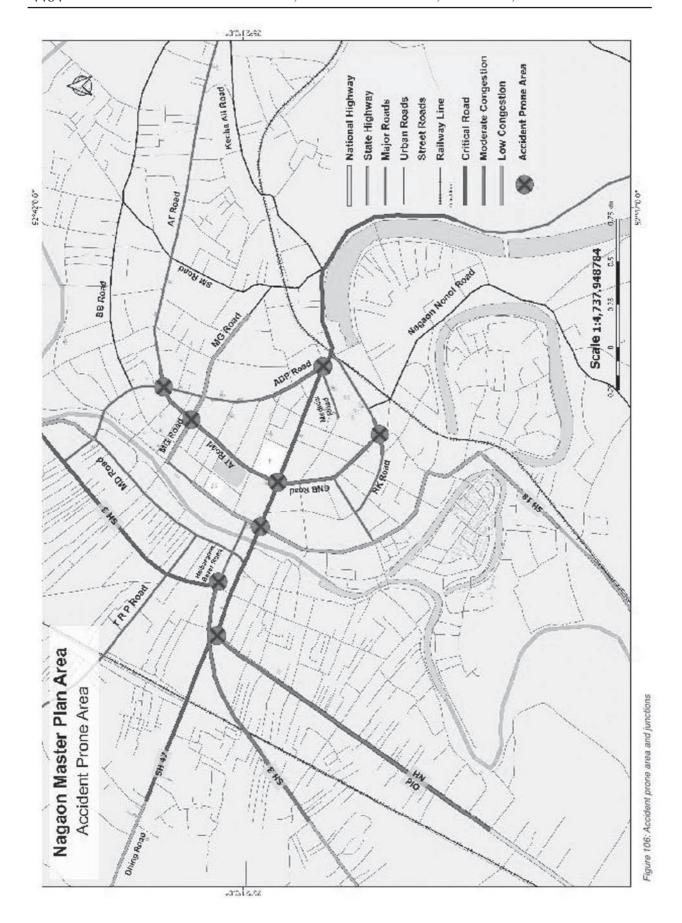
Table 123 V/C ratio on Major roads

Sr no	Location	ADT	V/C
1	Haiborgaon Bazar road	10592	0.60
2	ADP road	10404	0.59
3	SH-47 Dhing road	14474	0.83
4	SH-3 (Lathabori-Haiborgaon Bazar road)	9598	0.55
5	Old NH (Nagaon Morigaon road)	9971	0.57
6	SH-3 (Laokhowa)	17238	0.99
7	Nagaon-Lumbding road	14168	0.81
8	GNB road	12453	0.71

6.5.10 OVERVIEW OF CRITICAL ROADS

Road capacity in general refers to the maximum traffic flow obtainable on a given roadway using all available lanes. Critical roads depend upon several factors, mainly, traffic conditions, road geometry characteristics, environmental factors etc. The critical assessment of road capacities on major urban roads is carried out by field traffic surveys to capture the classified volume count for primary, secondary, and tertiary roads spread across the city through manual as well as video graphic techniques. Based on the collected data, the existing traffic volume per lane was ascertained during peak hours. This has been compared with the maximum Road capacity values to critically analyse the existing capacity potential of major roads in the city. Based on our study, the critical roads were observed and depicted in Map given below. The critical roads, depicted with blue color, include, SH-47 (Dhing road), SH-3 (Laokhowa) and Nagaon-Lumbding road, indicates that there is need to decongest the roads and propose for road widening in order to ensure free flow of traffic movement in NMPA.

Nagaon Master Plan Area
Critical Road Map

Legend:
- Master Plan Area
- National Highway
- State Highway
- Major Roads
- Urban Roads
- Street Roads
- Railway Line
- Critical Road
- Moderate Congestion
- Low Congestion

Scale 1:9,476.75492

0　　1　　2 km

Figure 105: Critical road map

Figure 106: Accident prone area and junctions

6.6 VEHICULAR TRAVEL PATTERN

The travel pattern of vehicles in the project area was studied. The data collected from the field was subsequently grouped according to origin and destination of vehicles, which led to development of the zoning system The Roadside Interview method, as detailed in IRC: 102-1988, has been adopted for O-D survey. The survey has been carried out for both passenger and goods vehicles for 12 hours (in both directions). For this purpose, cars (including new and old technology cars) and buses were considered as passenger vehicles. Similarly, LCVs, 2-Axle Trucks, 3-Axle Trucks, 4-6 Axle Trucks and >=7-Axle Trucks were considered as goods vehicles. Trained enumerators under the supervision of Traffic Police collected the travel information.

6.6.1 ZONING SYSTEM

Origin-Destination (OD) analysis is required for designation of the PIA in terms of codified origin and destination zones. It is thus important to code the trips recorded at site for origin and destination zones. The zoning, emanating from the understanding of the surrounding road network and the travel pattern of the vehicles by the consultants, was done in four levels. In the first level, all-important towns located along the study stretches were assigned zone code. Secondly, immediate influence areas of study stretches were considered, and nearby areas/ towns were defined as

6.6.2 DATA CODING AND CHECKING

The collected data were coded and computerized. Checking of data for incorrect entries and coding was carried out by cross checking with original field data sheets. The data were also checked for inconsistencies. The checking included:

- Code number exceeding highest code
- Matching vehicle type with commodity carried
- Vehicle type with their corresponding lead/load/occupancy for any inconsistencies

6.6.3 DEVELOPMENT OF ORIGIN-DESTINATION MATRICES

After coding of Origin and Destination data, expansion factors were calculated by comparing the sample size collected for each vehicle type with traffic count data. After calculating expansion factors, Vehicle wise O-D matrices were developed. Based on O-D matrices, travel pattern of the vehicles moving on the project road was determined. The O-D matrices of all 6 locations were combined to arrive at the project O-D matrix.

6.6.4 COMMODITY ANALYSIS

Commodity movement pattern shows that there is considerable movement of mining products, food grains & other agricultural products, finished & manufactured products and building materials. A large proportion of empty vehicles were also recorded. Mode-wise distribution of various commodities is presented in Table 124.

Table 124 Vehicle Wise Commodity Distribution (In Percentage)

Sr no	Commodity Analysis	LCV	MCV	HCV	MAV
1	Food grains, other agricultural products	8	3	0	0
2	Fruits, vegetables - perishables	15	1	0	0
3	Wood, Forest Products	0	0	0	0
4	Petroleum, oil, gas, lubricants	3	0	0	0
5	Minerals, chemicals, fertilizer	2	0	0	0
6	Iron, metal, steel	1	0	0	0
7	Finished & manufactured products	5	1	0	0
8	Building materials	12	3	0	0
9	Mining materials (Sand, Bajri, Coarse Aggregate)	14	4	0	0
10	Cement	4	0	0	0
11	Miscellaneous goods (Livestock, Waste, paper etc)	1	1	0	0
12	Empty vehicles	18	3	1	0

6.7 ORIGIN-DESTINATION SURVEY

6.7.1 PASSENGER VEHICLE

The analysis of passenger vehicles shows that maximum traffic (46%) circulates within Nagaon City. Traffic between Nagaon City and another district also observed 46% where major traffic flow plays between Nagaon and Guhawati as 6%. .and 2% traffic ply between Nagaon and Tezpur. Spatial distribution of passenger trips is presented in Table 125.

Table 125 Major Trip Distribution of Vehicles

Between	% Share
Guwahati	42
Babejia	10%
Dimargurhi	10%
Sensuwa	14%
Samaguri	09%
Nagaon to Rest of Districts	15%

6.7.2 FREIGHT VEHICLES

Analysis of goods vehicles shows that 38% freight trips are within Nagaon City and 42% freight is from Nagaon to another district wherein 17% trip plays to Guwahati city. The trips with Nagaon City and Tezpur were recorded at 3%. Table 126 shows the distribution of freight trips.

Table 126 Distribution of freight vehicle

Between	% Share
Within Nagaon City	38%
Outside Nagaon City	42%
Nagaon to Guwahati	17%
Nagaon to Tezpur	3%

(Source: Consultant Compilation)

6.7.3 OCCUPANCY AND TRIP PURPOSE

The analysis of OD data for passenger cars and buses shows that the average occupancy for these vehicles along the project road is 3 and 32. It is observed that the major share of trips is related to work. The distribution of car passengers by trip purpose is shown in Table 127.

Table 127 Distribution of Car Passengers by Trip Purpose

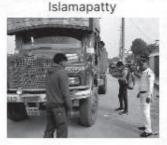| Trip Purpose	% Trips
Work	79%
Business	14%
Education	4%
Others	1%

6.8 JUNCTION ANALYSIS

The areas with major traffic congestion have been marked with red spots in figure no 107. These are the junctions which observed with frequent traffic congestions due to many haphazard vehicle parking, encroachment by mobile vendors, improper junction designs and insufficient space for vehicle movement. The identified juctions for analysis are Dhing gate junction, Haiborgaon tiniali, Haiborgaon-Laokhowa road junction, Natun Bazar chariali, Marikonlong (Civil Hospital gate) and Decapatty junction.

Table 128: The major traffic nodes of Nagaon city.

Sr. No.	Location of point	Description
1	Nagaon college police point	Entry to the Bara Bazar, DC court, to some banks, educational institute and offices. It is also a connecting point of NH-36 and NH-37. The NH-36 started from this point.
2	Civil Hospital point	Entry to the main market (Barabazar), Civil Hospital and to some Administrative centre such as Sadar Thana, BSNL Head Office and to some private bus stand.
3	Jayasree Cinema Hall point.	It is a commercial centre of the town consisting of major shops, entry to many offices, ASTC bus stand, some educational centre and act as a transfer point of passenger.
4	Natun bazar point	This is a commercial place consist of some shops, daily vegetable market and link with some educational centres.
5	Rajasthan Hotel point	It is also a business centre consist of variety of major shops. Numbers of banks are situated in this area, entry to bus stand, Nurul Amin stadium Govt. Boy's H.S.S.L.C School and Nehru Bali Field.
6	Panigaon Chariali point	Entry to ITI, ITI daily market, polytechnic, B.ED college, central school and entry to some offices and residential areas.
7	Alpinsthan Cinema Hall point	Entry to the Barabazar Daily Market, Civil Hospital.
8	Morikalong Chariali police point	Entry to the main town and to some educational institution and offices.
9	Dhing Rail Gate point	It is an important traffic intersection and transfer point. It is also a main appoint entry to the heart of the town and to the Haibargaon main commercial area. A lot of traffic is generated from the railway junction due to its multi-faceted activities.
10	Morigaon Bus stand Chariali point	Entry to the Haibargaon Daily Market and to some residential area, this point also act as transfer of passenger.

6.8.1 ALL OBSERVED JUNCTIONS

Major intersections within Nagaon Masterplan area have been categorized in five different types viz. 1. Round abouts/ Rotary 2. Cross – intersection 3. Y – intersection 4. T – intersection 5. Skewed T – intersections. All identified junctions are mentioned below according to their categories. Tables below represents the roundabouts, cross junctions, Y-junctions, T junctions and Skewed T junctions in Nagaon Master plan area.

Table 129 List of Rotaries in Nagaon MP area

Sl. No.	Roundabouts/Rotary
1.	NH 37 – NH 36
2.	AT road – NH 37

Table 130 List of cross junctions in Nagaon MP area

Sl. No.	Cross Junctions
1.	Laokhowa road- Tarun Phukan road
2.	Dhing road – Old NH
3.	MD Road – ADP road
4.	Haibor Bazar Road – MD road
5.	SH 18- MG road
6.	GNB Road – AT road
7.	MG road – ADP road
8.	Nagaon Lumding road – AT road
9.	ADP road – AT Road
10.	MG Road – AT road
11.	GNB road – Nagaon kampur road
12.	GNB road – Bimla Bora road

Table 131 List of Y - Junctions in Nagaon MP area

Sl. No.	Y - Junction
1.	ADP road – Bara Bazar road
2.	Medical road- Das road
3.	AT road – Kecha ali road
4.	MG road – SM Road

Table 132 List of T - Junctions in Nagaon MP area

Sl. No.	T - Junction
1.	Laokhowa road-ADP Road
2.	BB road – ADP road
3.	MG road- Neherubali Park road
4.	MD road –Tarun Phukan Road
5.	SH-18 – Kampur road
6.	At road – Dimorugiri Junction
Sl. No.	**Skewed T - Junction**
1.	BB road- BMC road
2.	MD road -Lakhaowa road
3.	SH-3 – LNB road
4.	Old NH – Dhing Road

(Source: Compiled by Consultants)

The map below shows the analysis of junctions whether the junction is Cross junction, T-junction, Y-junction, or Rotary (refer figure 107).

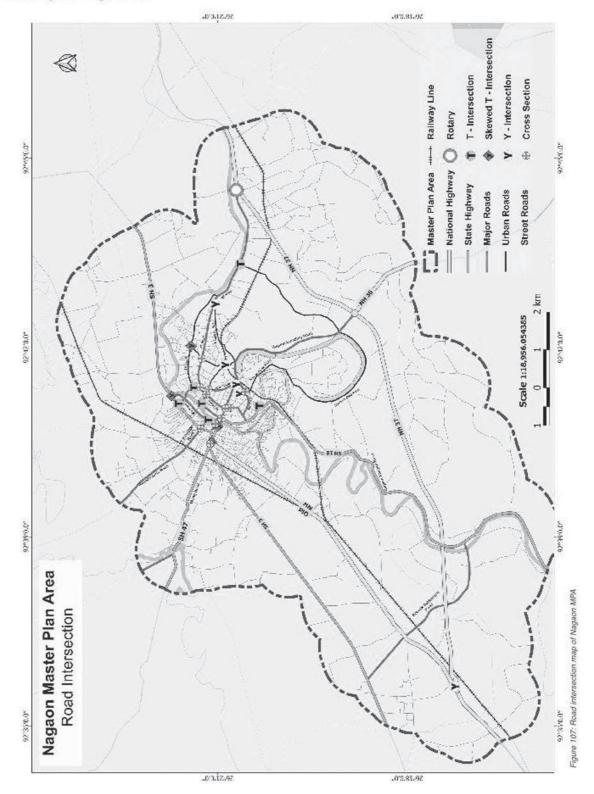
Figure 107: Road intersection map of Nagaon MPA

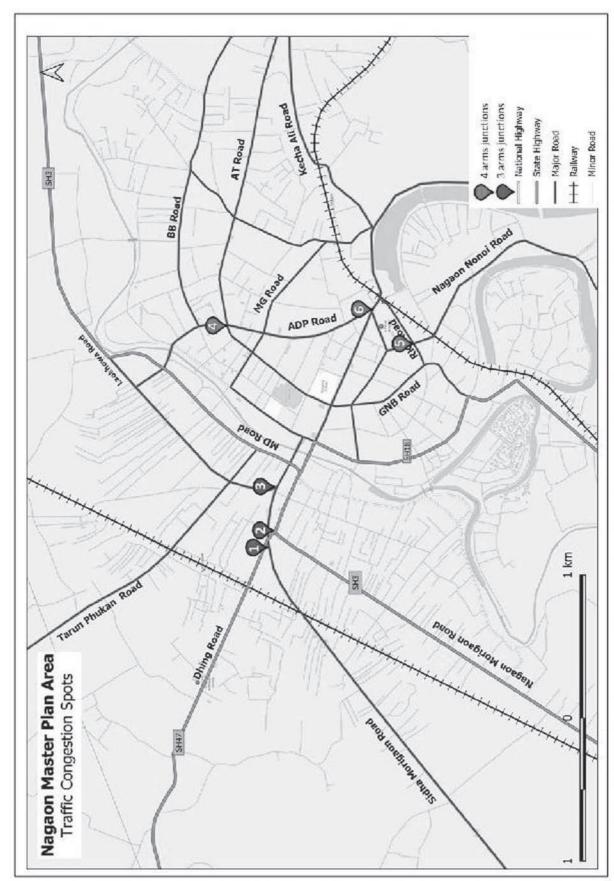Figure 108: Three and Four arm intersections

Figure 109: Major nodes of intersections

6.8.2 INTERSECTION - 1 (DHING GATE JUNCTION)

Table 133 Intersection 1 Traffic Congestion Details

Road	C. W. Width (m)	No. of Lanes	Shoulder + Footpath Width (m)	Peak Congestion Hours
SH- 47 (Dhing road)	8	2 lane Undivided Two-way	2.5	10:30 hrs. &16:30 hrs.
SH- 3 (Lathabori to Old AT)	12	2 lane Undivided Two-way	4	

This Junction is a 3-arm junction and the total daily traffic at SH-47 and on SH3 Junction is 14874 PCU. The peak hour and peak hour traffic at the junction are presented in table no. 134.

Table 134 Peak hour traffic at Dhing gate Junction

Peak Hour	10:00-11:00
Peak Hour Traffic (PCU/hr)	905

(Source: Compiled by Consultants)

The current capacity of junction may be improved by removing encroachment, electricity poles and vendors along with geometric improvement and signalisation.

Table 135 Veh/Day at Dhing gate Junction

Location	Minor Road (Veh/ day)	Major Road (Veh/ Day)
SH-47 (Dhing road)- SH-3 road junction	9598	14474

(Source: Compiled by Consultants)

6.8.3 INTERSECTION - 2 (HAIBORGAON TENIALI)

Table 136 Intersection 2 Traffic Congestion Details

Road	C. W. Width (m)	No. of Lanes	Shoulder + Footpath Width (m)	Peak Congestion Hours
Old NH	12	2 lanes undivided Two-way	4	
SH-3 (Haibor Bazar – Lakhaow Junction)	12	2 lanes undivided Two-way	2.5	10:30 hrs. &16:30 hrs.
SH- 47 (Old AT road)	8	2 lane Undivided Two-way	2.5	

Figure 110: Haiborgaon teniali junction

Haiborgaon Tiniali is a 3-arm junction and the total daily traffic at this junction is 14874 PCU. The peak hour and peak hour traffic at the junction is presented in Table 137.

Table 137 Peak hour traffic at Haiborgaon tiniali Junction

Peak Hour	10:00-11:00
Peak Hour Traffic (PCU/hr)	1228

(Source: Compiled by Consultants)

The current capacity of junction may be improved by removing encroachment, electricity poles and vendors along with geometric improvement, channelization and signalisation.

Table 138 Veh/Day at Haiborgaon tiniali Junction

Location	Minor Road (Veh/ day)	Major Road (Veh/ Day)
Haiborgaon tiniali	9971	14474

(Source: Compiled by Consultants)

6.8.4 INTERSECTION - 3 (HAIBORGAON JUNCTION)

Table 139 Intersection 3 Traffic Congestion Details

Road	C. W. Width (m)	No. of Lanes	Shoulder + Footpath Width (m)	Peak Congestion Hours
SH 3 (Haibor Bazar to MD roadi)	12	2 lanes undivided Two-way	2.5	10:30 hrs. &16:30 hrs.
SH 47 (Old AT road)	8	2 lane Undivided Two-way	2.5	

(Source: Compiled by Consultants)

Figure 111: Haiborgaon junction

Haiborgaon Junction is a 3-Arm junction and the total daily traffic at this junction is 16929 PCU. The peak hour and peak hour traffic at the junction are presented in Table140.

Table 140 Peak hour traffic at Haiborgaon Junction

Peak Hour	10:00-11:00
Peak Hour Traffic (PCU/hr)	1434

(Source: Compiled by Consultants)

The current capacity of junction may be improved by removing encroachment and electricity poles along with geometric improvement, channelization, and signalisation.

Table 141 Veh/Day at Haiborgaon Junction

Location	Minor Road (Veh/day)	Major Road (Veh/Day)
SH-47 – Laokhowa road intersection	14474	17238

(Source: Compiled by Consultants)

6.8.5 INTERSECTION – 4 (NATUN BAZAR CHARIALI)

Table 142 Intersection 4 Traffic Congestion Details

Road	C. W. Width (m)	No. of Lanes	Shoulder + Footpath Width (m)	Peak Congestion Hours
ADP road	6	2 lanes undivided Two-way	2	10:30 hrs. &16:30 hrs.
AT Road	10	2 lane Undivided Two-way	2.5	

(Source: Compiled by Consultants)
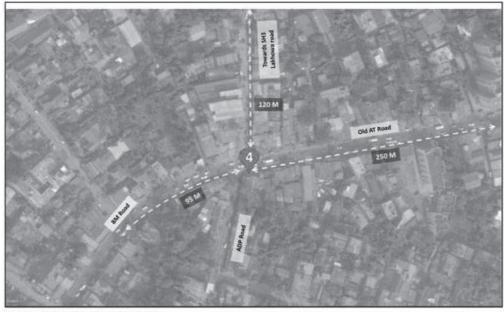
Figure 112: Natun Bazaar Chariali junction

Nutan Bazar Junction is a 3-Arm junction and the total daily traffic at junction is 9872 PCU. The peak hour and peak hour traffic at the junction are presented in Table 143.

Table 143 Peak hour traffic at Nutan bazar Junction

Peak Hour	10:00-11:00
Peak Hour Traffic (PCU/hr)	905

(Source: Compiled by Consultants)

The current capacity of junction may be improved by removing encroachment, electricity poles and vendors along with geometric improvement, channelization, and signalisation.

Table 144 Veh/Day at Nutan bazar Junction

Location	Minor Road (Veh/day)	Major Road (Veh/Day)
Natun Bazar chariali	10404	10592

(Source: Compiled by Consultants)

6.8.6 INTERSECTION – 5 (MARIKOLONG)

Table 145 Intersection 5 Traffic Congestion Details

Road	C. W. Width (m)	No. of Lanes	Shoulder + Footpath Width (m)	Peak Congestion Hours
Nagaon Lumding Road	10	2 lanes undivided Two-way	2.5	10:30 hrs. &16:30 hrs.
GNB Road	8	2 lanes undivided Two-way	1	

(Source: Compiled by Consultants)

Figure 113: Morikolong junction

Morikolong Junction is a 4-Arm junction and the total daily traffic at Morikolong Junction is 13556 PCU. The peak hour and peak hour traffic at the junction is presented in Table 146.

Table 146 Peak hour traffic at Morikolong Junction

Peak Hour	10:00-11:00
Peak Hour Traffic (PCU/hr)	1210

(Source: Compiled by Consultants)

The current capacity of junction may be improved by removing encroachment, electricity poles and vendors along with geometric improvement, channelization and signalisation.

Table 147 Veh/Day at Morikolong Junction

Location	Minor Road (Veh/day)	Major Road (Veh/Day)
Nagaon Lumding -GNB intersection	12453	14168

(Source: Compiled by Consultants)

6.8.7 INTERSECTION - 6 (DECAPATTY)

Table 148 Intersection 6 Traffic Congestion Details

Road	C. W. Width (m)	No. of Lanes	Shoulder + Footpath Width (m)	Peak Congestion Hours
AT Road	10	2 lanes undivided Two-way	2.5	10:30 hrs. &10:30 hrs.
GNB Road	8	2 lane undivided Two-way	1	

(Source: Compiled by Consultants)
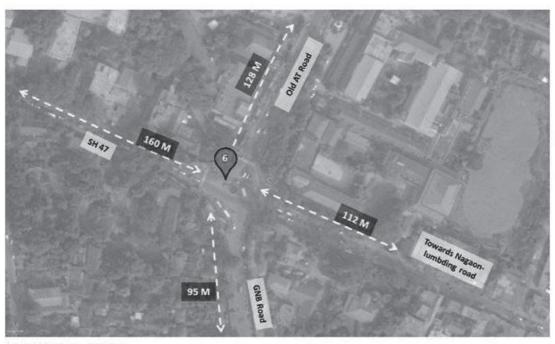
Figure 114: Decapatty junction

Decapatty Junction is a 4-Arm junction and the total daily traffic at the Junction is 11749 PCU. The peak hour and peak hour traffic at the junction is presented in Table 149.

Table 149 Peak hour traffic at Decapatty Junction

Peak Hour	10:00-11:00
Peak Hour Traffic (PCU/hr)	1110

(Source: Compiled by Consultants)

The current capacity of junction may be improved by removing encroachment and electricity poles along with geometric improvement, channelization and signalisation.

Table 150 Veh/Day at Decapatty Junction

Location	Minor Road (Veh/day)	Major Road (Veh/ Day)
Decapatty	10592	12453

(Source: Compiled by Consultants)
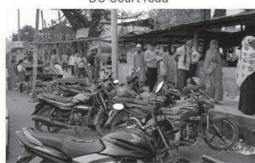
6.9 PEDESTRIAN SURVEY

Pedestrian survey was conducted both along the road and across the road near New market area on Barabazaar, DC court, Haiborgaon Bazar and Stadium Market

Haiborgaon Bazar road

DC Court road

Bara Bazar Market road

Stadium Market road

Table 151 Pedestrian Survey Data, NMPA

Location	Peak Hour	Passenger Flow	Existing Footpath width (m)	Required Footpath width (m)
Barabazar	16:00 – 17:00	1045	1.5	2
DC court	16:00 – 17:00	895	1.2	1.5
Haiborgaon Bazar	16:00 – 17:00	1255	1.3	2
Stadium Market	16:00 – 17:00	990	2	1.5

IRC 103 recommends the min. footpath width as 1.5m. Hence it is recommended that the footpath width on Bara Bazar and Haiborgaon Bazar road to be increased to 2m.

Pedestrian-vehicular conflict can be effectively studied through the indicator PV2 suggested in IRC 103,'Guidelines for Pedestrian Facilities'. The code suggests some form of control measures at mid blocks and intersections where the indicator PV2 is greater than or equal to 1 x 108 for undivided carriageways where 'P' is the peak hour pedestrian volume and 'V' is the number of vehicles in that peak hour. Analysis of the peak values for PV2 and the hour in which the same is observed is presented in Table 152.

Table 152 Pedestrian Cross traffic survey

Location	Peak Hour	P	V	PV²/10⁸
Barabazar	16:00 – 17:00	1045	874	7.9
DC court	16:00 – 17:00	895	798	5.6
Haiborgaon Bazar	16:00 – 17:00	1255	751	7.0
Stadium Market	16:00 – 17:00	990	650	4.1

(Source: Compiled by Consultants)

Huge pedestrian traffic volume is observed along the links and intersections within the core areas – as walking is one of the dominant modes of movement.

Most of the links do not have adequate footpaths on both sides to accommodate the high pedestrian volume. Many Streets observed with huge encroachment on footpaths by local vendors and commercial facility owners which forcing pedestrians to move along the carriageway. The major deficiencies are:

1. Inadequate/irregular riser and tread
2. Poor surface condition
3. Poor illumination
4. Lack of railing and landing facilities for long flight of steps

As walking is the only effective Non-Motorized Transit (NMT) mode, management of pedestrian facilities along with steps and accessibility on footpaths can significantly boost the patronage for NMT movement within NMPA.

6.10 SPEED DELAY SURVEY

The survey was conducted along four major travel corridors. Journey and Running speeds derived from the survey in the two directions of travel are presented in Table 153.

Table 153 Observed Speed along Project road

Sr. No.	Road Section	Direction	Journey Speed (kmph)	Running Speed (kmph)
1.	Haiborgaon Bazar road	SH-18 – MD road junction to Haiborgaon junction	13.9	23.5
		Haiborgaon junction to SH-18 – MD road junction	15.6	28.6
2.	Dhing Road	Dhing gate to Dhing road flyover	27.8	35.4
		Dhing road flyover to Dhing gate	28.2	32.5
3.	GNB Road	Decapatty to Bara Bazar	24.8	35.6
		Bara Bazar to Decapatty	25.6	39.3
4.	Lumding road	Civil Gate to Morikolong	18.5	32.4
		Morikolong to Civil Gate	18.3	33.5

(Source: Compiled by Consultants)

The low values of Journey and Running speeds indicate major congestion. Thus, intervention is required to relieve congestion through capacity augmentation and traffic management.

6.11 PARKING STUDY

The parking of vehicles needs extensive and exclusive land area. On street parking is found all over Nagaon, parking usually spills over to other use areas like road carriageway and footpaths, open spaces. In turn they affect safety and environmental quality. Parking characteristics within the town vary by areas, by land use activities and by time period. In residential areas it is by private vehicles and of long-term duration during the night hours. In central areas it is of mixed type – private and public vehicles, passenger and goods vehicles and of short term and long-term needs. In industrial, warehousing and wholesale market areas it is predominantly of goods vehicles

A space occupied by vehicle for a particular period of time when it is not under any use can be known as parking. If any vehicle comes on road, it always requires a parking to rest as a human requires bed to rest for a particular time period, so it is recommended in these days for any busy landuse activity to come up with proper parking plans for required number of vehicles. The parking in urban areas is found to be of two types namely on-street parking which is done on the side of streets with space provided and other is off-street parking which is a modern concept and is done when there is a lack of space in the urban area.

6.11.1 EXISTING PARKING AVAILABILITY

The parking areas are an important component in the urban transportation network. The parking areas become very important in the Central Business District areas (CBD) and public activity area, where the traffic movement is very heavy. At present around 0.27 hectare of open land on Lumding road near Morikolong river has been utilized as formal private unorganized parking specifically for LMVs. There is no such Municipal identified parking area designated for public parking within planning area. Presntly, one open plot on SH-3 Shani Mandir road of size 0.13 hectare has been utilized as HMV vehicle parking area.

Table 154 Parking Spots and their Area Coverage

Parking Space/ Area	Location	Type of Parking	Area (Hectare)
Pvt. Car Parking Area	Lunding road	unorganized ground level parking	0.27
ASTC Parking	Nagaon Morigaon Bus stop	unorganized ground level parking	0.1
Truck Parking (Pvt.)	SH-3, Shani Mandir road	Private parking, unorganized ground level parking	0.13

At present there is no multilevel organized parking facility been provided within CBD area urban local body control. There are 2 organized paid parking facility available in public spaces like Nagaon Railway Terminus and at Nagaon ASTC terminal.

Apart from mentioned unidentified area, the on-street parking also practiced in the entire Nagaon town area where heavy traffic movement or public activity is observed.

Bara bazaar road street

DC Court road street

On-Street parking

Stadium Market Road

6.11.2 PARKING SURVEY

High ownership pattern and excessive dependence on private mode of movement, i.e., two-wheelers and cars exert huge parking demand. As most of the parking demand is met by on-street facilities due to absence of designated off-street facilities, leading to traffic congestion in the core area.

Parking survey was conducted at on street locations where vehicular parking was observed. On-street parking is observed to be high on Bara Bazar Road and Stadium Market Road. The percentage of vehicles parked for long-term (>1 hr) is high at the two locations constituting 93% at Bara Bazar and 84% at Stadium Market Road. Analysis of parking demand is presented in Table 155.

Table 155 Existing Parking Demand in Equivalent Car Space

Sr. No.	Location	Parking Type	Peak Accumulation (ECS)	Peak Hour
1	Barabazar	On Street	165	16:00 - 18:00
2	DC court	On Street	145	13:00 - 14:00
3	Haiborgaon Bazar	On Street	123	11:00 - 16:00
4	Stadium Market	On Street	154	11:00 - 16:00

Table 156 Parking Demand Capacity Analysis

Sr. No.	Location	Demand (ECS)	Capacity (ECS)	Demand/ Capacity
1	Barabazar	165	60	2.75
2	DC court	145	-	-
3	Haiborgaon Bazar	123	-	-
4	Stadium Market	154	-	-
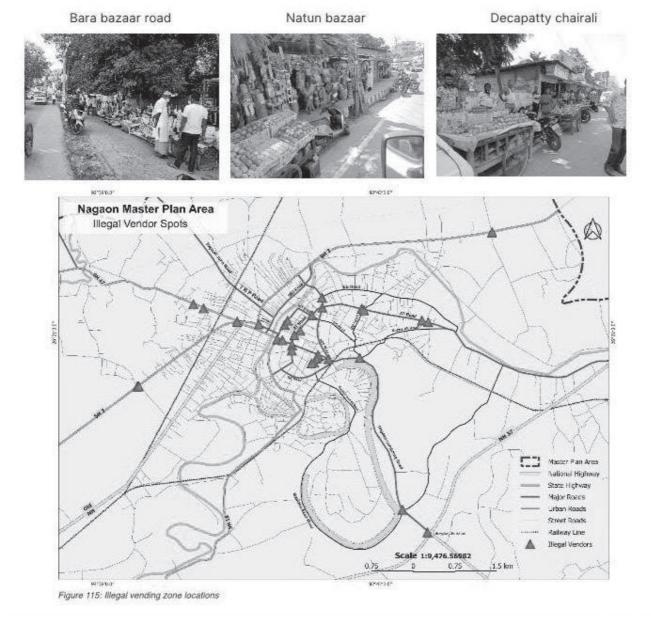
As evident from the above table 156, the parallel parking spaces on Bara bazar is fully saturated and leading to sever encroachment on street, however that on Haiborgaon Bazar Road, DC court road and Stadium market road there is no designated parking space available which leads to encroachment on most patches. After haphazard parking of vehicles, about 5m space is only available as roadway at the mentioned locations. Interference to through traffic is caused during parking, un-parking operations. Thus, the on-street parking lots result in considerable congestion. During reconnaissance survey, On-street Parking has been observed at various locations like AT Road, Laokhowa road, Old NH Road, SH 47 intersection, and MG Road in Nagaon Planning Area leading to massive congestion and decreasing the road capacity. In view of this, there is dire need for providing off street parking facility in potential commercial areas or in proximity in CBD area. Multi-level parking can be resorted to provide the needed parking facilities.

6.12 ISSUES AND REQUIREMENTS

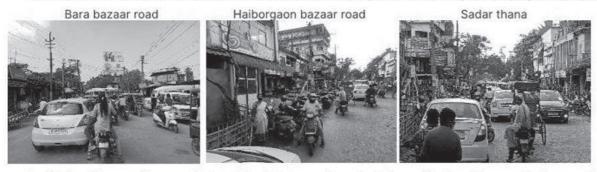## 6.12.1 ILLEGAL VENDING ZONE

- One of the major issues is of illegal vending on walking shoulders on the main streets.
- Due to this illegal vending sometimes the actual accessible patch of road decrease to half lane only.
- If proper spaces are being allocated to street vendors in every zone the issue can be eliminated.
- Due to illegal possession of shoulders the pedestrian come down to road for their local trip and some time proves unsafe on congested area.
- Narrow road network with restricted capacity, particularly due to the illegal vending, resulting in congestion and loss of productivity.
- The problematic areas include Intersection Natun Bazar Chairali, Decapatty Area, Bara bazaar road and Stadium market have this illegal vendings.
- The photographs below depict the current scenario of the illegal vending zones which restricted the capacity of road which in result lead to congestion.
- The illegal vending zone locations have been marked on the map (Fig. 115)

Bara bazaar road   Natun bazaar   Decapatty chairali

Figure 115: Illegal vending zone locations

6.12.2 TRAFFIC CONGESTION

- Traffic congestion is quite common, and it takes a lot of time to commute for the commuters.
- At many places geometry of roads and intersection are not adequate and absence of functional hierarchy of road network leads to the traffic congestion.
- The average roads width of the town is very less as they have not followed any norms and standards for the road pattern as well as for other related things like road cross sections, etc.
- Observed encroachments on the footpath by vendors, which acutely rise the traffic congestion between include Intersection **Haiborgaon Chairali, DC court Area, Bara bazaar road and Stadium market have this illegal vendings.**and parking on both sides of the road and the resultant traffic need to resolve.
- Many vehicles, due to lack of adequate parking facilities, were parked on the CD Court road, causing inconvenience to people who use the field for recreational purposes like walking and playing and people

Bara bazaar road	Haiborgaon bazaar road	Sadar thana

had to face inconvenience as that road leads to many important places like **Bara Bazaar, stadium market and Haiborgaon chairali.**

- Other roads having traffic congestion are SH-47 (Dhing road) (11mt.), SH-3 (MD to Palasoni road) (18mt.), GNB road (8.7mt.) and Nagaon- Lumding (19mt.)
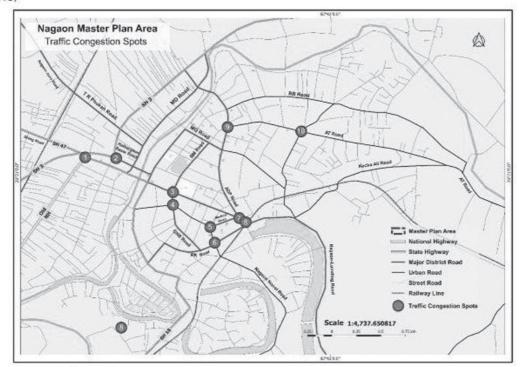- The highlighted light Red dots on map within town area shows the frequent congested road patches (Fig. 116)

Figure 116: Traffic congestion spots

6.12.3 ROAD ENCROACHMENTS

- Many factors can be listed out for such happenings, but few observations are mentioned below, which are
- Unauthorized parking of vehicle on pavement only.
- Many spots with exposed electric poles on pavement sides which leads to make space dead and potential for parking wheels.

Haiborgaon road	Civil gate	Decapatty chairali

- The town suffers from parking problems due to encroachment by vendors on road and off-street parking. As a result, the road width decreases and there is no space remaining to pass the vehicles or to give space to other vehicles.
- There is no designated space for parking in whole town.
- There are encroachment issues in areas namely both sides of Haiborgaon road, Civil gate road, and Decappaty road.
- Due to lack of space, it is difficult for vehicles to pass on.
- Also, Proper facilities are needed for loading, uplifting, and downloading.
- Encroachment on both sides of the road decreases the effective width which may cause road accidents and disturbs the smooth flow of traffic.
- The map shows the road network of planning area with identified spots of encroachment within NMPA.
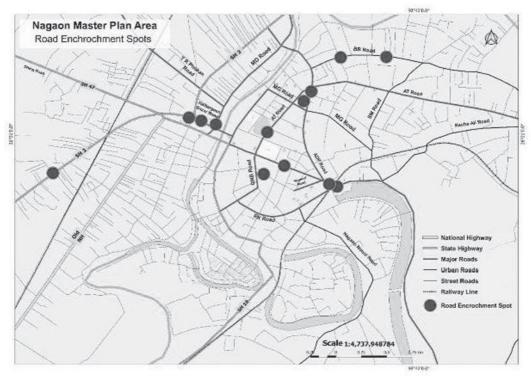
Figure 117: road encroachment spots

6.12.4 HAPHAZARD PARKING AREA

- With increasing number of vehicles, narrow roads, absence of parking spaces within majority of built areas, parking becomes critical for planning and development.
- There is more of commercial area, so the shopkeepers park their vehicles outside the shops leading to decrease in the width of the road.
- There is no proper arrangement for parking vehicles which results into roadside parking.
- Some of the streets are observed by frequent haphazard parking on side of the pavements.
- Low accessibility and traffic congestion are resulting due to such happenings.

Haiborgaon road	BM road	ADP road

- As per the temporal study the town is growing at fast rate leads to more and more traffic problems like todays it does not have sufficient parking and also number of vehicles are increased rapidly which will lead to the parking shortage in the town.
- **The areas with illegal parking are near BM Road, ADP road, Laokhowa road, Bara bazar road, Haibor bazar road, opposite Stadium along Stadium Market Road, MG Road, AT Road, Civil gate, Medical road, DC court road and along Decapatty area,**
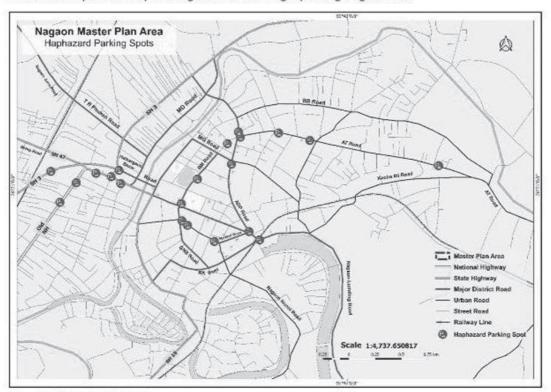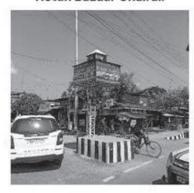- The marked spots on map are regular area for illegal parking (Figure 118).

Figure 118: Haphazard parking locations

6.12.5 JUNCTIONS WITHOUT TRAFFIC SIGNALS

- Many traffic intersections observed with insufficient traffic control facility
- The below mentioned are junction with Non -working traffic signals
- Resulting in unnecessary traffic jams and more requirement of traffic brigade occurs.

Notun Bazaar Chairali   **Panigaon Chairali**   **Haiborgaon Bazaar road**

- Various junctions without traffic signals are there in town like Civil hospital gate, Natun Bazar Chariali, AT Road, Decapatty tiniali, Panigaon Chariali, Haibor gaon bazar road junction, Dhing gate junction, ADP road – AT road junction, MG road – SH 18 junction, etc. As no junction is signalized which leads to the poor infrastructure of the road.
- The marked spots on map are junctions without traffic signal (Figure 119).
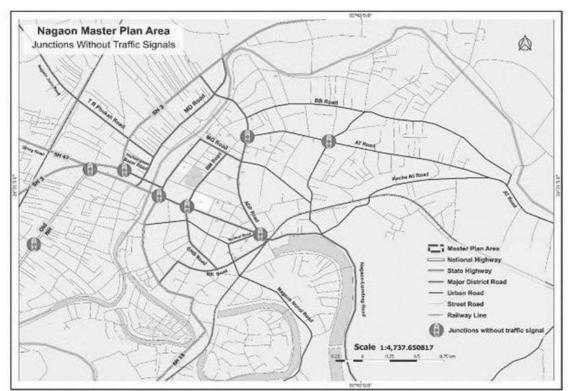
Figure 119: Junctions without traffic control facilities

6.13 PROPOSALS AND RECOMMENDATIONS

6.13.1 GRADE SEPARATION PROPOSAL

Grade separation is the separation of the levels at which roads cross one another to prevent conflicting rows of traffic or the possibility of accidents. Here the existing road is single lane with the 7 m of carriage way which is proposed to be a 4-lane road. The proposed location of grade separator is depicted in figure 120.
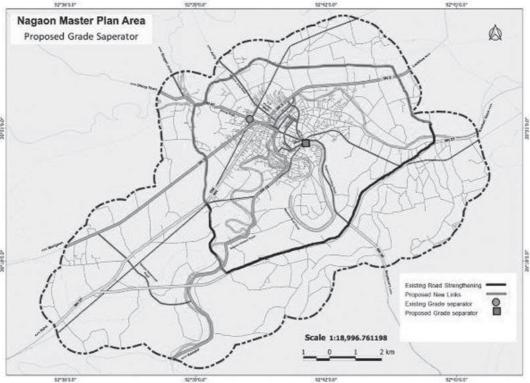

Figure 120: Proposed grade separator location

7.13.1.1 Road Over Bridge (ROB)

A grade separator has been proposed on Nagaon- Lumbding Road which will divert the traffic and solve the issue of congestion due to railway line barrier. This is proposed on the NH-37 and bypass road intersection. Refer figure 121 where the elevated section is shown with blue colour and the ram is shown in pink color.

Table 157 Road details of Intersection 1 - Grade Separation Proposal

Road	C.W. Width (m)	Lanes
Nagaon-Lumbding Road	7.5	2 lanes undivided Two-way
Civil Gate Road	7.2	2 lanes undivided Two-way

The proposal of flyover is given as per the traffic congestion observed and considering the analysis conclusions. The possibility of construction of overbridge from Nagaon town Civil Hospital Gate to Morikolong allocated Bus Parking area to ease out the traffic blocking and bottel neck situation in daily peak working hours.

Figure 121: Proposed ROB at Railway Crossing near Civil Gate
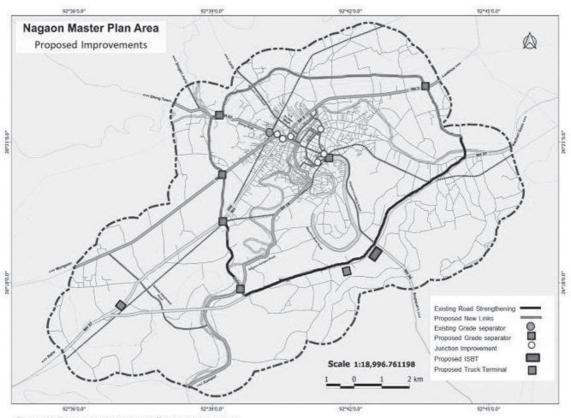
6.13.2 RING ROAD PROPOSAL

Figure 122: Proposed Improvements in Transport Infrastructure

6.13.2.1 Widening and Acquisition in Proposed Ring Road

Table 158 Ring Road Description

Sl. No.	Road Section	Length (km)	Existing C. W. (m)	Available Road Width (m)	Proposed Road Width (m)	Proposed Configuration
2	NH 37	10.4	20	40	60	6 lanes divided (widening required)
3	Sensuwa Road	2.4	5	6.7	45	4 lanes divided (widening required)
7	New Link 1	16.45	-	-	45	4 lanes divided (land acquisition required)
8	New Link 2	0.75	-	-	45	4 lanes divided (land acquisition required)
Total		30.00				

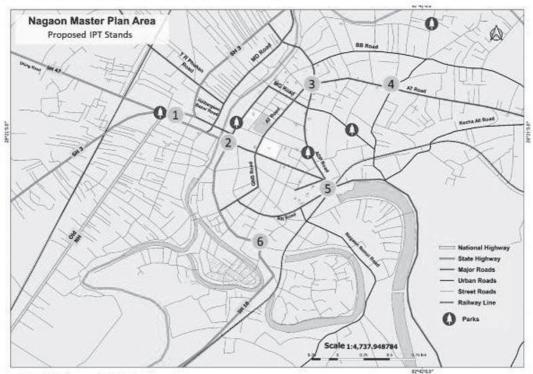## 6.13.3 PROPOSED IPT STANDS AND ROUTES

Table 123: Proposed IPT stands

Intermediate Public Transport (IPT), sometimes known as Paratransit, refers to road vehicles used on hire for flexible passenger transportation, which do not follow a fixed time schedule. They may or may not follow a fixed route. It will be much viable if proper space allocation being done for the passanger transfer movement at prime locations. Here, mentioned in map are identified IPT stand for passenger's safe trasfer for one mode to another mode.

Figure 124: Proposal for IPT stands location

6.13.4 JUNCTION IMPROVEMENT

6.13.4.1 Intersection - 1 (Dihing Road- Lathabri – AT road)

The current capacity of junction may be improved by widening the road width of Dihing road by 24 mt. with divided 4 lanes, removing electricity poles and vendors along with geometric improvement and signalisation. Widening of SH-3 Road will ease out maneuvering movement of vehicle around junction.
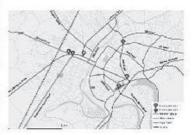
7.13.4.2Intersection - 2 (Haiborgaon Junction)

The current capacity of junction may be improved by widening the road width of AT Road by 24 mt. with divided 4 lanes, removing electricity poles and vendors along with geometric improvement and signalisation. Widening of Haibor bazar road up to 18 mt will ease out maneuvering movement of vehicle around junction.

7.13.4.3 Intersection - 3 (Haiborbazar- Laokhowa Road)

The current capacity of junction may be improved by widening the road width of haibor bazar Road upto 24 mt. and Laokhowa road upto 24 mt. with divided 4 lanes. Additionally, removing electricity poles and Adhoc vendors along with channelization of junction, geometric improvement and signalisation will ease out the traffic condition at junction

7.13.4.4   Intersection - 4 (Natun Bazar Junction)

The current capacity of junction may be improved by widening the road width of AT Road by 18 mt. Additionally, removing electricity poles and vendors along with geometric improvement and signalisation. Widening the road width of ADP road upto 15 mt. with median provision will ease out maneuvering movement of vehicle around junction.

6.13.5 ROAD HIERARCHY

It is important to device a street classification which is in consideration with the proposed landuse. The roads are classified into the following 3 categories according to their function and activities that take place along the road.

Table 159 Road Category Proposed for Nagaon Planning Area

Sr. no	Category	Characteristics	ROW
1.	Arterial	• City to City linking • Largest volumes of traffic • Commercial/Mixed residential uses are predominant along the road	60 m
2.	Sub-Arterial	Mixed residential Use along the road • Feeding traffic to arterial roads	24 m & 30m
3.	Major Roads	Connecting residential areas with sub arterial roads/arterial roads	18 m & 24 m

6.13.5.1 Arterial Road

A typical cross section of an arterial road is given in the figure below. It shall have carriageways, median, Multi Functional Zones (MFZ), service lanes and footpaths. Multi functional zone is a zone to accommodate street components such as tree planting, auto rickshaw stand, hawkers zone, bus stop, traffic police booth, fire hydrants, street lights etc. as per the requirement. The RoW of the arterial roads varies between 45m and 60m
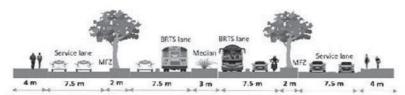

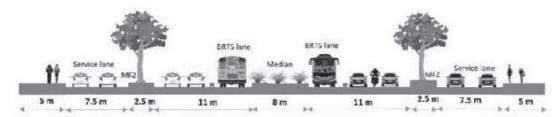Figure 125 Cross Section of 45m wide Arterial Road

Figure 126: Cross Section of 60m wide Arterial Road

7.13.5.2 Sub-Arterial Roads

Sub arterial roads shall have carriage ways, median, service lanes, Multi-Functional Zones and sidewalks as shown in the figure 126. As mentioned earlier, the RoW of the sub-arterial road is between 24m or 30m.
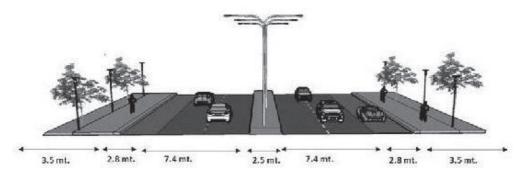

Figure 127: Cross Section of 30m wide Sub-Arterial Road

7.13.5.3 Major Roads

Major roads shall have Carriage ways, median, Multi Functional Zones and sidewalks as shown in the figure 128. As mentioned earlier, the width of the major road is either 18m or 24m.
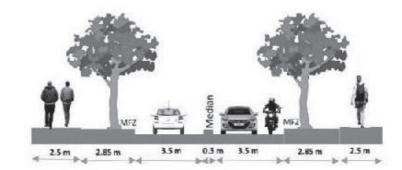

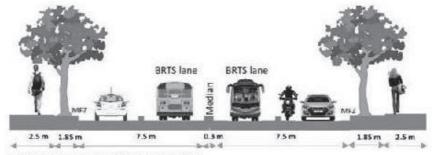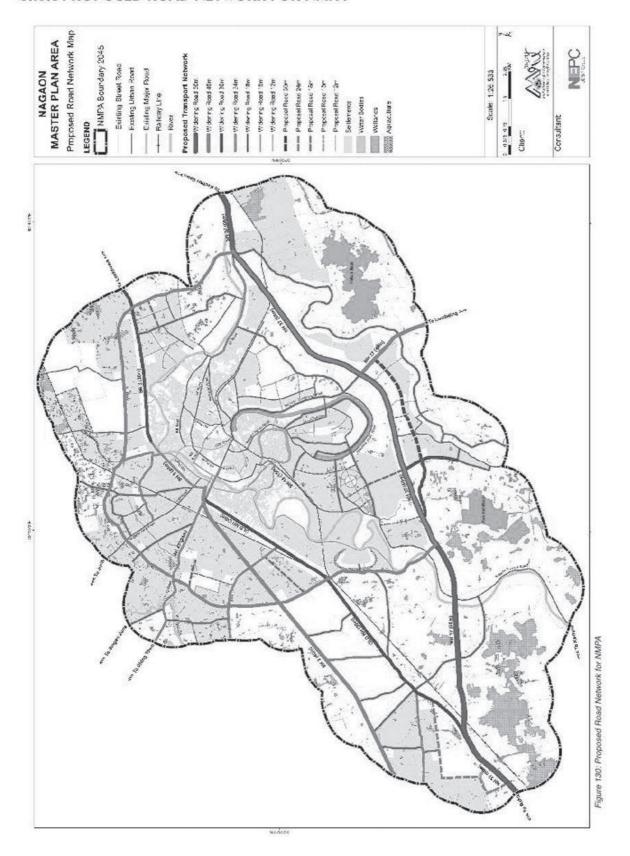Figure 128: Cross Section of 18m wide Major Road

Figure 129: Cross Section of 24m wide Major Road

6.13.6 PROPOSED ROAD NETWORK FOR NMPA

Figure 130: Proposed Road Network for NMPA

6.13.7 MULTILEVEL, ON-STREET AND OFF-STREET PARKING

As discussed above in section 6.12 Issues, there is no dedicated parking space available in Nagaon Planning Area. Due to the dier need of parking spaces, Multi-Level Car Parking facilities are proposed at one location. Multi-Level Car Parkings are proposed at space of present Lanka Bus Stand near Civil Hospital. The need of Multi Level Car Parking will also be required near Existing Railway Station. Multi-Level Car Parking is also suggested to be proposed on the existing site of Railway Station. Rest of the locations are identified for on street and off street ground parkings. The Locations are as mentioned below.
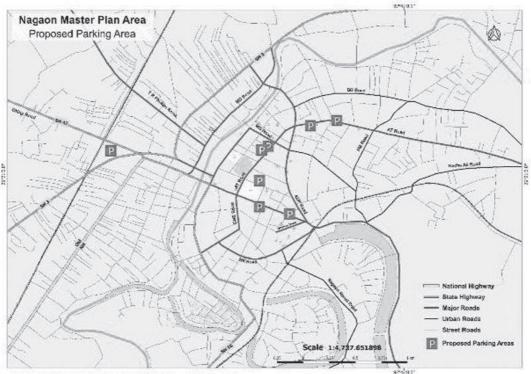
Figure 131: Proposed Parking Area within Municipal Board Area

Two on-street parking locations have been identified on strrets between AT Road and BM Road in core city centre area. This paid parking bays will cater the parking demand emerges due to ongoing commercial and retail activity on AT Road market streatch area. Four off street parking locations identified, namely FCI godown (rehabilated at proposed WTC), closed Morigaon Bus stop, Private Guwahati Bus stand and open plot at AT Road.

6.13.8 PUBLIC TRANSPORT PROPOSALS

6.13.8.1 BRTS (Bus Rapid Transit System)

Bus Rapid Transit System (BRTS) are generally a high-quality bus based transit system that focuses its operations in large urban areas with fast, comfortable, cost effective services catered for larger commuter populations. BRTS achieves it through the adoption of dedicated lanes with bus bays and bus stations typically aligned to the center of the road, off board fare collection and fast and frequent operations.

Figure 132: Bus Rapid Transit System

BRTS is similar to a light rail system, it is considered to be more reliable, convenient and faster than regular bus services due to the fact that they run on dedicate bus bays and hence not delayed by the regular city traffic.

The Nagaon City bus system needs to be improved to attract a large portion of the commuters to avoid the use of private vehicles in favour of public transport. For this the prevailing city bus system needs to be strengthened, this can act as a support for the mass rapid transit systems which are elaborated above. BRTS is a successful system adopted by many Indian cities like Ahmedabad and Indore. Due to faster implementation, lesser capital investment BRTS is a good alternative for sustainable transport solution for the planning area. BRTS can be implemented along the major transit corridors like NH-37, SH-3,, SH-18, Old NH and other major roads like Laokhowa Road, AT Road, Nagaon-Lumbding Road. Due to the non-contiguous nature of the planning area BRTS on these said roads might have to pass through normal traffic in areas which falls under core city centre, this might affect the operational advantage of BRTS systems.

7 INFRASTRUCTURE & PUBLIC UTILITIES

Infrastructure is the key determinant to the community which decide the functions towards their socio-economic development of the city. Facilision of sustainable development the physical and social infrastructure are very much essential. Physical and social Infrastructure is the basic requirement which decides the quality of urban and rural life & overall productivity of the people. This chapter deals with the analysis of existing conditions of physical infrastructure such as Water Supply, Sewerage System, Solid Waste Management and Power as well as social infrastructure viz., Health and Educational facilities. Based on the analysis and clear understanding of existing scenario, future predicted the physical and social infrastructure for the projected year 2045.

In the formulation of infrastructure plan, attention was given to the followings. Emergency task is to directly respond to the basic needs of physical and social infrastructure both for the present communities and new settlement of the returnees.

Needs survey at the community level is a fundamental study for preparation of urgent rehabilitation and development programs for basic physical and social infrastructure. The plan is to be prepared as practicable and flexible one by staging the needs and level of services of basic infrastructure. Institutional strengthening and capacity building will be carried out through actual planning and construction of the basic infrastructure, at the Community, State Government and GOSS levels.
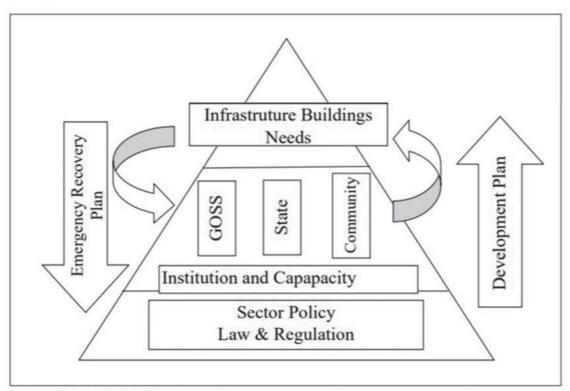

Figure 137 Conceptual Constitution for Infrastructure Plan

7.1   PHYSICAL INFRASTRUCTURE

Infrastructure is the basic physical structures needed for the operation of a society for an economy to function and physical networks that support society.Socio- economic growth of a town/city and the physical Infrastructure development in the town.Urban physical infrastructure (UPI) is one of the major assets of a city in terms of capital investment, critical services provisioning, and sustainable and resilient urban development. UPI includes physical objects like roads, sewerage, energy networks. Various data regarding details about amount of water supply, Hours of Supply, number of bore wells, details of sewerage system viz. capacity of STPs and details of drainage etc. have been procured from Public Health Division of PWD, Nagaon.

Nagaon Master Plan Area has the population of **2,98,680 (**Census, 2011) and the population is projected to increase up to **4,64,221** for the horizon year 2045. Therefore, in order to meet the future demand, calculation of the same for various sectors is necessary and the same is dealt with in this chapter.

7.1.1   WATER SUPPLY

Urban water supply infrastructure has often been designed with a focus on treatment and distribution and with only minimal consideration of source water characteristics. Sustainable urban water supply systems must link more closely with the natural water systems in which they are located. one of the important and essential resource of Water for the development any Region, saunter supply of the suffice the domestic, industrial and irrigation requirements within the planning area. Presently the planning area is influential on both part of ground and surface water sources to address the water requirements of the area. Due to the non-contiguous geomorphic nature of the planning area and for better management water supply within the planning area is divided into two parts, urban area and rural area.

7.1.1.1   Existing Water Supply Project under Execution

Water supply is one of the important infrastructure services for a city/town and a proper supply of water for its population ensures the city have strong basic infrastructure. The map showing the boundary of the area covered by PHED for water supply is given in the figure 138. Total water supplied quantities is 40.55 MLD and the main source of the water supply is Ground water.
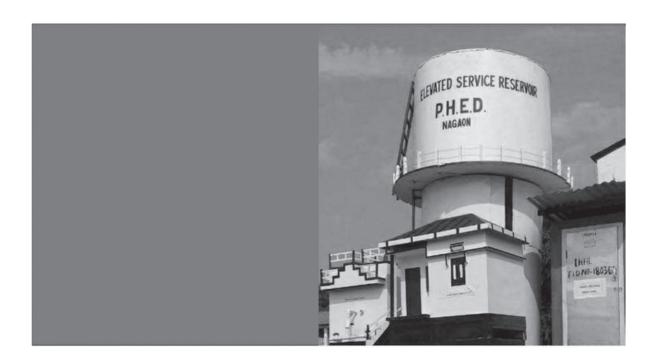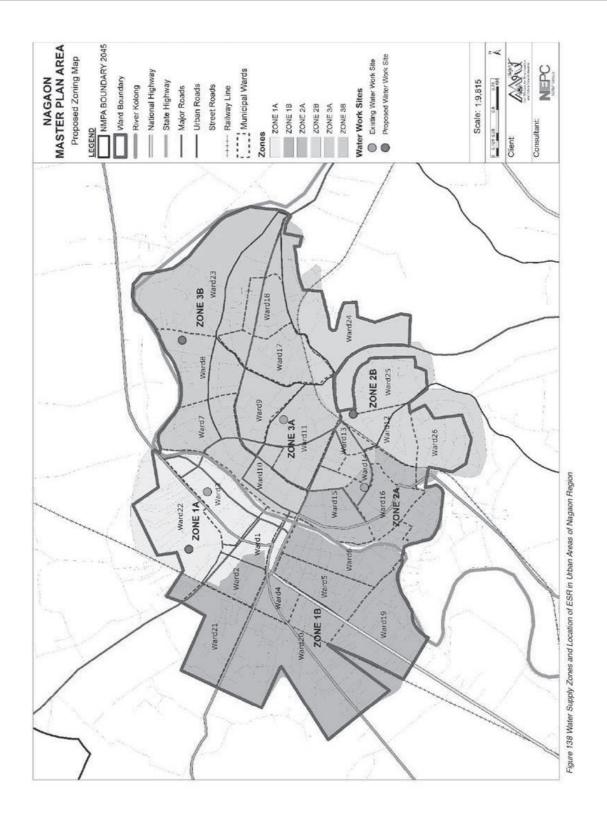
Table 161 Data of Water supply project urnder excution by AMRUT

Sl.No.	Parameters	Details		
1	Location	Laokhowa Road	Fauzdaripatty	Meturpatty, R.K Road
2	Type of Reservoir	ESR (Elevated Service Reservoir)		
3	Water sources	Borewells		
4	Capacity of the ESR	1230558 L	1000743 L	1824328 L
5	Capacity of the Clear Water Sump	153654 L	124460 L	221280 L
6	Quantity of water supplied	40.55 MLD		
7	Sources of water supply	Ground water		
8	Dimension of Clear Water Sump	126 cu/m	126 cu/m	243 cu/m
9	Location of intake point	i) Madhav Dev Road ii) Inside Campus	i)Kadamtal ii) Inside Campus	i) R.K Road ii) Inside Campus
10	No of Raw Water Pump	2 Nos	2 Nos	2 Nos
11	Bore Well Depth (RWPM)	400 ft.	400 ft.	400 ft.
12	Discharge Flow (Raw Water Pump)	250 L/M	250 L/M	250 L/M
13	Discharge (Clear Water Pump)	228 cubic metre/ Hr	228 cubic metre/ Hr	228 cubic metre/ Hr
14	Outlet from the ESR	2 nos Delivery Line (14 inch & 12 inch of CI pipe) 1 no Backwash Line (10inch CI pipe) 1 no overflow line	1 nos Delivery Line (12 inch of CI pipe) 1 no Backwash Line (12inch CI pipe) 1 no overflow line	2 nos Delivery Line (14 inch & 12 inch of CI pipe) 1 no Backwash Line (10inch CI pipe) 1 no overflow line
15	Water level below ground level	10 feet	15 feet	15 feet
16	Clear Water Pump	6 Times Daily (45 Minute each)	6 Times Daily (45 Minute each)	6 Times Daily (45 Minute each)
17	Length of network in all 3 zones	113 KM.		

(Source: Water Supply project, AMRUT)

Figure 138 Water Supply Zones and Location of ESR in Urban Areas of Nagaon Region

71.1.2 Calculation of Future Demand Projections

In order to calculate the demand for a projected year, it has to be calculated for certain stages as per CPHEEO Manual. The four stages are mentioned below:

1. Intermediate Stage (10 years from the base year) - 2031

2. Ultimate stage demand (25 years from the base year) - 2045

The water supply demand should include the fire demand, institutional demand etc. as per the CPHEEO guideline. In order to calculate the demand, it is essential to calculate the projected population for the defined stages. The domestic water supply demand is taken as 135 lpcd. The Projected population considered for this project is as under As it is seen from the below table, the total demand for 2021 is 55.52 MLD and for final stage is 85.28 MLD. Currently, total water being supplied to Nagaon is 40.55 MLD. The total deficit for base year is 7.51 MLD and for the final stage it is 44.73 MLD.

- To meet the future demand, following proposals have been made under this project:
- 3 numbers of RO plants will be installed.
- Approx 12 number of new tube wells will be constructed
- New collection wells need be constructed

Sl. No	Particular	Popu lation	Amount of Water supply (LPCD)	Total demand in MLD	Popul ation	Amount of Water supply (LPCD)	Total demand in MLD	Popul ation	Amount of Water supply (LPCD)	Total demand in MLD	Popul ation	Amount of Water supply (LPCD)	Total demand in MLD
	Year		2011			2021			2031			2045	
1	Demand for existing population	298680	135	40.32	346140	135	46.72	392696	135	53.01	464221	135	62.66
2	Fire Demand 100*((population)/1000^1/2)/1000			1.7			1.8			1.9			2.1
3	Unaccounted Water (15%)			6.04			7			7.95			9.4
4	**Total Demand**			**48.06**			**55.52**			**62.86**			**74.16**

Table 162 Water Demand assessment for Water Supply Source & Rehabilitation System

7.1.1.3 Summary of Water Demand

Table 163 Summary of Water Demand for 2045

Sr. No.	Particulars	Water Demand for 2045
1	Total Projected Population for MPA	464221
2	Water Demand @ 135 lpcd for planning area in 2045	62.66
3	Fire Demand Unaccounted Water	(2.1+9.4) = 11.5
4	Total Water Demand	74.16 MLD
5	Total Water Demand (including Water loss @ 15% of water demand)	85.28 MLD
6	WTP Capacity	85.28
7	Storage – GLSR @ 67% of WTP	57.14
8	Storage – ESR @ 33% of WTP	28.14

The Water Demand of entire planning area for 2045 will be around 85.28 MLD including fire demand and 15% of water losses during water supply. In absence of water treatment plan in planning area, there is an urgent need of Water Treatment Plant. Additional GLSR & OHT storage requirement is to be provided considering the future requirements of year 2045 respectively 57.14 and 28.14. The capacity of OHT and GLSR are worked out based on the thumb rules set for calculating storage capacity

7.1.1.4 Proposed Strategies

There is an additional requirement of 44.73 MLD (existing supply 40.55 MLD) water to meet the drinking water demand of Nagaon Planning Area by horizon year 2045. As ground water potential of the area appears reasonably enough to support the drinking water needs, the present trend of relying solely on it may continue. But, apart from providing individual tube wells, a system of collector wells (cluster of tube wells) with an arrangement for treating the raw ground water is recommended for safe drinking water. Majority of the drinking water demand can be met using the surface/sub-surface flow of River Kolong as a source of supply through collector wells/intake wells.

Action Plan

- Planning, design and implementation of a sustainable water supply scheme mainly based on surface/sub-surface/intake wells water supply from the river Kalong and ground water
- Covering the entire planning area with a continuous water supply system assuring 24 hr supply with adequate pressure in the distribution system even at the tail ends
- Controlled use and management of ground water assuring treatment with disinfectants before distribution

- Public awareness against misuse of water
- Adequate reforms so as to balance the O&M cost with the revenue out of the water supply distribution

For areas outside conurbation, respective Commune Panchayats will have to arrange for the water supply without hampering the environment.

Rainwater Harvesting

Rain water harvesting must be made mandatory in newly developed houses to increase ground water potentials.

Desilting of Tanks

The water tanks located outside conurbation area are recommended to undergo desilting process. This will increase the capacity of the tanks and ultimately lead to better ground water recharge.

Ground Water Recharging

As agricultural land is being converted to urban use, identifying sites for additionalgroundwater recharge is essential to keep water supplies balanced. The existing village tanks which are normally silted and damaged can be modified to serve as recharge structure. The village tanks can be converted into recharge

structure. Several such tanks are available which can be modified for enhancing ground water. Construction of Percolation well is also an option for ground water recharge.

Recycling of Grey Water

Recycling of Grey Water is proposed for Car wash, landscaping, industrial cooling, flushing etc. Recycling of Grey Water should be promoted.

7.1.2 SEWERAGE SYSTEM

As at present, Nagaon does not have an integrated planned sewerage management system, and majority houses in the city have septic tanks, of which many are not maintained well; hence, overflowing and dysfunctional. In fact, many septic tanks are now non-functional because of the high water table, and as a result, much of the untreated wastewater directly flows into the storm water drains or into the natural drainage channels. It is a high time that the authority plan and implement proper public wastewater collection and disposal system to ensure that sewage or excreta and sludge discharged from communities is properly collected, transported, treated to the required degree and finally disposed off without causing any health or environmental problems.

As per the survey done, present wastewater generation by Nagaon town is approximately 16037.6 KLD but there is no STP provision done for sewerage generated by town.

Table 164 Sewerage Generation Calculation

Sr. no.	Area	Population	Water consumption (KLD)	Sewage generation (KLD)	No. of STPs proposed	Existing Treatment capacity (KLD)	Gaps in KLD
1	Nagaon	1,48,496	20046.9	16037.6	01	Nil	160

(Source: Action plan for Kolong river, PCB, Assam)

7.1.2.1 Estimation of Wastewater Generation

The total water requirement for the Master Plan Area is 85.28 MLD (by the year 2045). As per CHPEEO guideline, 80% of total water demand is considered as the sewerage flow; therefore, around 68 MLD water is expected to go in sewerage lines. As time passes, the area is expected to grow and along with high water demand, there will be larger wastewater discharge; hence, the project area required systematic sewerage system so the wastewater will not be discharged in the natural drains, which will help in reducing the flood problem.

There should be underground sewerage connection to each households and from where the discharged wastewater should go to sewerage treatment plant before discharging it into the natural drains. While planning for the proposed sewerage system, consideration should be given to the natural drainage pattern. The sewerage system should be planned in such a way that there will be minimum pumping involved in collection and conveyance of sewage. New Sewerage Treatment Plant (STP) sites should be identified depending on considerations such as the quantum of environmentally suitable land, and availability of government land, capital and O&M cost of different options. While the underground sewerage is been planned and implement, the authority needs to make sure that each household in the region has a septic tank installed and is being managed and is fully functioned. Water from commercial and industrial activities wastewater is being treated before discharging in the river.

7.1.2.2 Issues

- **Absence of sewerage system:** there is absolute absence of sewerage system in Nagaon planning area resulting in discharge of un-treated waste water in drains and river Salandi
- **Mixing of storm water and sewage:** In absence of sewerage and improper drainage system, in many parts of planning area, there is discharge of sewage into storm water drains and other water bodies
- **Maintenance of Septic Tank:** As per the present practice, the septic tanks are the only mode of disposal of sewage in Nagaon planning area, which are not frequently cleaned by the Nagaon Municipal Board.

- **Open Defecation:** Open defecation in slums and rural areas can be seen throughout the planning area and no efforts are taken till date.
- **Degradation of natural water bodies:** The disposal of waste water into river Kolong and in other water bodies resulting degradation and contamination of water and land.

7.1.2.3 Proposed Strategies

In a modern society, proper management of wastewater is a necessity, not an option. A wide range of communicable diseases can be spread through elements of the environment by human and animal waste products, if not disposed properly. The development of effective water and wastewater treatment methods has virtually eliminated major water borne epidemics in developed countries.

Developing countries like ours, where treated water is not available to a majority of the population, still experience epidemics like cholera and typhoid. It is also to be mentioned that as per the report of the Planning Commission for the Tenth Five Year Plan, which emphasizes that all cities, towns and industrial areas should compulsorily have sewage treatment plants and are to be implemented in a time bound manner. Advanced waste water treatment process is currently being so developed that it

will produce palatable water from domestic wastewater.

Recommendations

- For treatment of waste water generated from the planning area, a decentralized wastewater treatment system would be more appropriate. The centralized sewage treatment system appears inappropriate as it may end up with very huge sizes of sewers and various issues of conveyance in handling this huge quantity of wastewater.
- The treatment plants and sewers are to be so aligned as to reduce the number of crossings with railway tracks and National Highways of the area. The proximities of natural drains for treated effluent disposal, minimum obstructions for laying sewers, and the possibilities of acquiring land for sewage treatment plants (STPs) turns important in orienting and locating the plants.
- The possibilities of re-use of treated wastewater effluent for irrigation, gardening etc. should be looked into.
- The construction of treatment plants could be carried out in a phased manner on a modular/zonal basis in the planning area consistent with the future development/demand.

7.1.3   STORM WATER DRAINAGE SYSTEM

The Assam Urban Infrastructure Investment Program is a key urban infrastructure initiative of the Government of Assam. The investment program aims to provide improved access to water supply, sanitation, and urban infrastructure facilities to the urban population in Nagaon. The project uses a multi tranche financing facility (MFF) modality and, requires the preparation of a Resettlement Framework and Resettlement Plan for all subprojects under the Program. The major outputs of this program include improved drainage in Nagaon to reduce economic losses due to flooding, and comprehensive SWM. The Plan states infrastructure bottlenecks and lack of long-term funds for infrastructure investment, is one of the main constraints for growth.

With the rapid urbanization as well as the expansion of the area Nagaon city, the existing drainage facilities are not sufficient to the needs of the demand of the people. Brick or earthen drains are found here and there without proper linkage which could not carry the excess run-off to the outlet, resulting in water logging at different areas of the city. At present the total length of the existing drainage in the city is 1196 km out of which 20% of the drains are lined and 80% of the drains are earthen. About 85% drains are maintained by NMB and 15% drains are maintained by APWD.

Presently a drainage project report has been prepared by Nagaon Municipality Board for improvement of 49 km. of drain at different areas of Nagaon city amounting to total project cost of Rs. 34.01 crores for NLCPR funding under Ministry of DoNER and it is submitted to the, Govt. of India for approval.

The benefits would be improved environmental and

living conditions and public health in Nagaon. In addition, the economic benefits considered due to the proposed project are: (i) reduction of household healthcare cost due to flooding and water logging problems; (ii) reductionin person-days lost due to water logging and flooding; (iii) reduction in temporary resettlement costdue to flooding; (iv) reduction in annual cost of protection measures from flooding; (v) reduction inannual agricultural loss; and (vi) reduction in road maintenance cost

Table 165 Length of open and covered drains

Sr. No.	Drains	Length of Drain (kilo metre)	Percentage
1	Covered Drains	40	20
2	Open Surface	156	80
	Total Length	196 km	100

7.1.2.1 Issues and Requirement

Open Channel Area:

- Closed channel water drainages are observed on many streets within municipal board where some streets are under progress.
- Unhygienic condition due to open channel leads to spread of diseases.
- It also leads to high health risk due to illegal discharge of wastewaters and solid waste.
- Another issue includes foul odour source establishment and becomes a breeding ground for insects and pests.
- Regular cleaning service is not done to remove solids from the open channel area which increases the chances of blockages which can cause spill-over and flooding.
- Open channel areas are differentiated into 3 parts and the locations are mentioned below:

The locations of open drainages are marked with major width along roadside

- Closed water drainages are observed on many streets within NMB, whereas some streets still need attention.
- Here marked green are the locations of open drainages with major width along roadside
- **Hinders accessibilit**y on road.
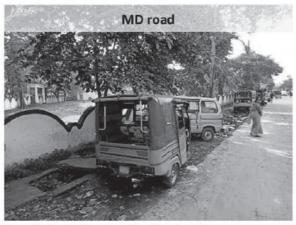- **Unhygienic condition** due to open channel leads to **spread of dieses.**

Figure 139 Showing MD road and Near Mecry hospital
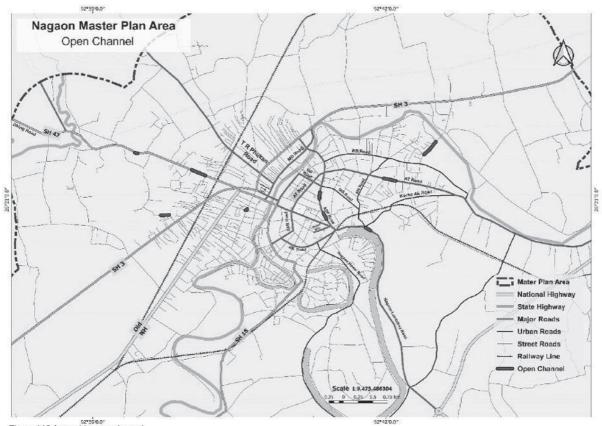
Flood Prone Areas:

Figure 140 Area with open channel

- Many low-lying areas are found under water logging within the city area.
- Due to absence of storm water drain, the rainwater and the flash water, in monsoon, are unable to flow down stream and due to this the area becomes prone to water logging.
- At many places, the accessibility on pavement hinders due to presence of water logging end hence sometimes become a reason for traffic congestion.
- The major flood prone areas include the portion of AT road and Dhing gate. Due to absence of storm water drain the rainwater and in monsoon the **flash flood water unable to flow down stream and due to this becomes prone to waterlogged area.**
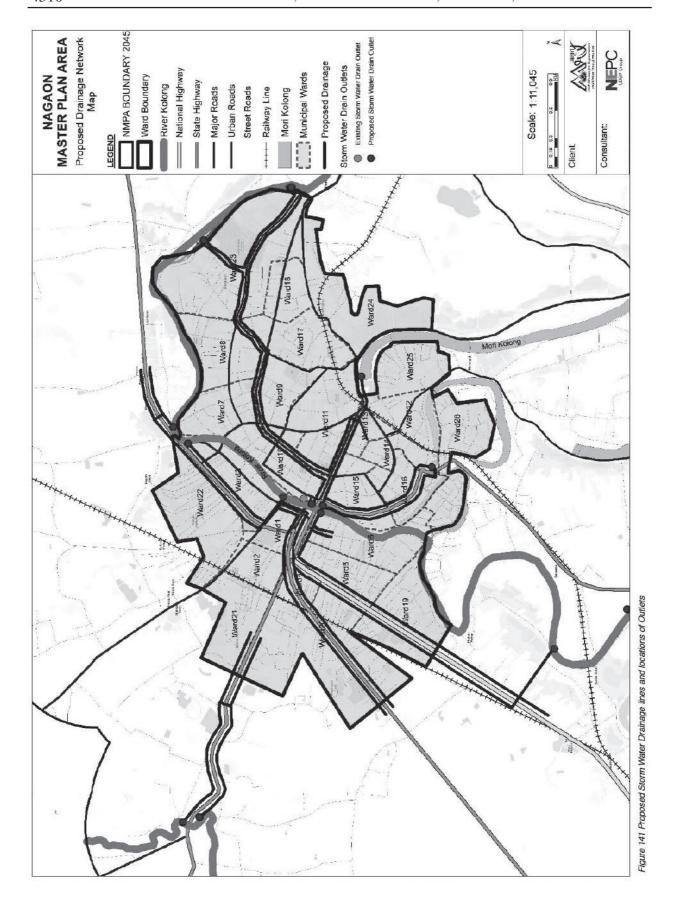
7.1.2.3 Proposed Strategies

A separate storm water drainage network has been proposed in the development area for the collection and safe disposal of storm water during rainfall. The design criteria to be followed for design of Storm Water Drainage network are broadly based on the recommendations as laid down in the CPHEEO Manual of Sewerage and Sewage Treatment, Ministry of Urban Development, Government of India and as per provisions laid down in the relevant I.S. Codes and Consultants' past experience in related field.

- Rectification of slope and width of drains shall be done, wherever required.
- Provision of new storm water drainage network as per phase wise requirements worked out considering key parameters of precipitation intensity, catchment delineation, percolation characteristics and surface runoff.

Recommendations

- The lack of proper sanitation and solid waste management, combined with indiscriminate dumping of solid waste in the drains reduces the carrying capacity of these natural drains. The implementation of a systematic solid waste and wastewater collection and treatment system is a necessary prerequisite for proper drainage of the area.
- The natural drains have been encroached upon and are almost in dilapidated state. Also, at many reaches the drain sidewalls are found to be damaged. The section of the drain is also irregular and less adequate at many locations. Proper gradient is not maintained at several stretches on its reach and the hydraulic parameters are also not uniform. Also, no definite drain section is maintained in many reaches. So, proper maintenance and management of the existing natural drains turns important. This necessitates a proper evaluation of the existing natural drainage system.
- Over the years the River Kolong has progressively silted up due to which the flood water flows at ever higher levels than the water levels in this main drain.
- The natural depressions and ponds, which were instrumental in preventing excess storm run-off, are getting filled up at a rapid rate due to urbanization. This may further aggravate the existing problem of water logging. It is necessary that 'natural sinks' be retained as such as, they are instrumental in controlling the water logging of the area.
- An organized drainage system is invariably associated with the implementation of a systematic solid waste and wastewater collection and treatment system.
- Periodic de-silting of the existing storm water drains should be done.
- Perimeter protection of all the major drains should be checked before every rainy season.
- Overall, the preparation and implementation of a master drainage plan appears essential for Nagaon planning area
- All roads of the town/city should have side-drains, which will serve as minor or tertiary drains
- Existing drains which can be used as storm water drains, need to be upgraded based on engineering aspects & runoff calculation
- A plan for the drainage of some of these areas has been prepared. The implementation of a master drainage plan for these areas appears very essential.

Figure 141 Proposed Storm Water Drainage lines and locations of Outlets

7.1.4 SOLID WASTE MANAGEMENT

At present, Solid waste management is one of the major challenges the Nagaon city is facing. The city has a formal garbage collection, and disposal system, which is insufficient to cater the total garbage generation in area and as a result it is affecting the living environment in the city.

7.1.4.1 Solid Waste Management in Urban Area

Presently, the solid waste generation in NMB area is 58.27 MT/Day whereas collection is 43.7 MT/Day as per Municipal Board record. Out of total collected waste, 20.27 MT found degradable and 23.43 MT as Biodegradable. No. of household covered in door-to-door waste collection are 11395 as per Municipal Board record. Vehicle deployed in Solid waste collection system are 13 Trippers, 52 Tricycles, 18 Hand cart, 4 Skid loader, 1 Excavator, 1 Focklane and 1 Compactor. Manpower deployed to run entire system are 2 Sanitary Supervisors, 98 Sweepers and 68 conservancy MR worker.

Citizens have habit of throwing garbage on streets, into the open drains, in the backyards, and in the open spaces. This section proposes explains the foreseen solid waste generation and the management for the same in the project area.

7.1.4.2 Quantity of Waste Generated

The quantity of MSW generated depends on numerous factors such as population, food habits, standard of living, degree of commercial activities and seasons. The increasing urbanization and changing lifestyles have increased the waste generation rate of Indian cities.

Criteria for assessing waste generation

- Projected populations for the design period
- Existing per-capita waste
- Annual rate of increase of per capita waste generation

7.1.4.3 Solid Waste Demand Projection

Based on the CPHEEO standards, following assumption were considered while estimating the volume of the solid waste and required area for the landfill site for the proposed urban population for the horizon year 2045:

- It is assumed, that MSW will be collected by responsible authorities at regular basis
- Characteristic of the collected MSW in the region will be the in consistent with the characteristics mentioned in CPHEEO manual.
- Per Capita Solid Waste Generation-270 Grams per Capita per Day

Table 166 Future assessment of Solid waste Generation

Sr. No.	Particulars	Demand for 2045
1	Projected Population	464221
2	Solid Waste Generation(in Conurbation area @270 gms/cap/day)	**125 MT**

7.1.4.4 Issues in Present System

Lack of Disposal Site

Presently, there is no engineered landfill, and Municipal Solid Waste is dumped in open area, which can lead to ground water and soil pollution, vector naissance etc.

Lack of Primary Collection System

Solid waste is discharged by establishment into open plots, open drains etc. these un-organized disposal methods have resulted in the accumulation of solid waste on roadsides, vacant plots, and storm water drains. This has resulted in a number of hygiene related problems such as breeding of flies/ mosquitoes and stray animals.

Un-hygienically Solid Waste Transportation

Municipal Solid Waste is transported primarily in open vehicles i.e. trucks, tippers and cycle rickshaw. It is also observed that these modes of transportations are overloaded with MSW, resulting in the littering of roads during transportation. The loading and unloading of waste are carried out manually, and Safai Karamcharis

involved in these activities do not use any safety measures.

In-sufficient collection and disposal of construction waste

The construction and demolition waste generated by residents is transported in tractor trolleys and disposed at either secondary collection points or open/low-lying areas in the town vicinity.

Handling of MSW with Slaughter Waste

Waste from the slaughters houses is disposed in open dumping sites, although there are provisions for separately disposing slaughter house waste in Nagaon town / planning area.

Disposed of Bio-medical waste without any treatment

Presently, there is no treatment facility available for bio-medical waste in Nagaon and Medical waste is disposed off along with general MSW

Lack of primary Collection points

Unattended waste lying in open areas is common phenomena in the entire town because of non-availability of required numbers of bins in the planning area

Multiple Handling of Wastes

The waste is handled multiple times leading to potential health hazards for the workers as all types of wastes contains hospital waste, human waste etc are disposed in the same containers

Lack of Awareness

There is absolute lack of awareness among people w.r.t. handling and management of waste.

7.1.4.5 Proposed Strategies

Decentralized solid waste treatment system:

The developmental pattern of all the areas, especially Nagaon, demands the implementation of an integrated solid waste treatment system. It is felt that only a decentralized MSW Management System could help solve the seemingly intricate problem of solid waste treatment in this area in an economically viable, socially desirable and environmentally sound manner.

Public Participation:

General environmental awareness and information on health risks due to improper solid waste management are important factors which need to be continuously communicated to all sectors of the population. Building awareness among public and community about the need for a better solid waste management system is as essential as management. Public awareness and attitudes to waste can affect the people's willingness to cooperate and participate in adequate waste management practices. If people keep on throwing waste on the streets indiscriminately, the local body alone cannot keep the city clean in spite of their best efforts .Thus, it is very important to make people understand that the treatment and management of solid waste is a collective responsibility of the local authority and the community. Municipalities or local governments through participatory programs should convey this message to the people.

Collection Enhancement facilities:

- Old dustbins are to be replaced with different types of covered dustbins, which reduces the time of pickup and improves the process of primary collection of wastes.
- Sweepers may be provided with handcarts and detachable containers and be allotted a fixed area or number of houses for door to door collection. They should also be provided with safety gears and proper uniforms.
- It can be made compulsory for the management of societies/complexes to keep covered bins in which waste is to be stored at acceptable locations, to be picked up by the municipal staff.
- The local body may collect waste from community bins by using container handcarts or tricycles whichever may be convenient, for transferring the wastes to the waste storage sites by employing municipality sweepers.
- The collection service can be provided on a full-cost recovery basis using contractor services on a dayto-day basis from individual houses.

- The collection service can be provided on a full-cost recovery basis using contractor services on a dayto-day basis from individual shops also. The service of rag pickers and part-time sweepers can also be used in agreement with the shop owners.
- Sweeping of all public roads, streets, and lanes, by-lanes where there is habitation or commercial activities on either side of the street should be done daily. A list of such streets and roads together with their length and width should be prepared. The local body, keeping in view the norms of work prescribed should work out a program for their daily cleaning. However, roads and streets where there is no habitation around and do not require daily cleaning may be put in a separate group.

Provision of Solid waste Storage:

One of the immediate measures to revamp the existing collection services structure would involve provision of covered community waste bins at proper distances for the people to deposit domestic waste. This is the first step that will ensure that people do not throw their garbage on the roads and hence do not create open dump sites. This will enable the sanitation workers to transfer waste to the transportation vehicle quickly and efficiently with minimum health risk which will also help to maintain the aesthetics of the surroundings. The Municipal solid waste (Management and Handling) Rules 2000 of the Government of India have prescribed the compliance criteria for waste storage depots as under:

- Storage facilities shall be created and established by taking into account quantities of waste generation in a given area and the population densities. A storage facility shall be so placed that it is accessible to users.
- Storage facilities to be set up by municipal authorities or any other agencies shall be so designed that waste stored are not exposed to open atmosphere and shall be aesthetically acceptable and userfriendly.
- Storage facilities or "bins" shall have "easy to operate" design for handling, transfer and transportation of waste. Bins for storage of biodegradable waste shall be painted green, those of recyclable waste shall

Table 167 Solid waste Generation Source

S.No.	Generation Source	Action Proposed
1	Residential	• Not to throw any waste in neighborhoods, on streets, open space, and vacant lands, in drains or water bodies. • Keep food waste / biodegradable waste in a non corrosive bin type – D1 • Keep hazardous waste separately • Keep dry/ recyclable waste in bin type – D2
2	Multistoried buildings, commercial complexes, private societies	• 1 to 4 as above. • Provide separate bin type – B large enough to hold wastes generated both biodegradable and recyclable. • Direct member of the association / society to deposits waste in bins provided. Sanitary inspectors should vigil the area and fineshould be imposed for not following the actions
3	Slums	• 1 to 4 as above. • Use bin type –C
4	Shops, offices, Institutions	• 1 to 4 as above. • Store the waste in bin type - D1, D2
5	Hotels and restaurant	• 1 to 4 as above • They should arrange their own bins and dispose waste in nearby municipal bins
6	Vegetable, fruit markets, meat, fish markets, and street Vendors	• Keep small baskets with them and transfer waste to large bin type-A. • Shop keepers not to dispose of the waste in front of their waste or shops or open space. • Deposit waste as and when generated into bin type-A. • Fines should be imposed for not following the action
7	Marriage halls, Community halls, Kalyan Mondaps	• 1 to 4 as above. • Provide a large bin type -B
8	Garden Waste	• Compost the waste in garden itself, if possible. • Store wastes in large bags or bins and transfers it to community bins.

Note: Bin Type A (volume 7 m3), Type B (0.75 m3), Type C (0.5 m3), Type D1 and Type D2 (12 liters)

be painted white and those of other wastes shall be painted black.

- Manual handling of waste shall be prohibited. If unavoidable due to constraints, manual handling shall be carried out under proper precaution with due care for safety of workers. So, the storage and handling of SW are extremely important, and hence the steps to be taken by the Municipal authorities for storage of solid wastes are detailed in table below:

Segregation:

These compositional characteristics of the solid waste underline the need for proper segregation before treatment. Proper segregation of waste into different components and their separate collection can definitely lead to remarkable changes in the entire system.

The segregation of the waste would be a long drawn exercise as it involves attitudinal changes in people and will have to be done with careful planning, in a phased manner. The general public is to be first sensitized towards the whole concept and educated about the need and advantages of doing the segregation. Segregation of waste at the source itself is extremely important as municipal solid waste, which is otherwise environmentally benign on getting mixed with hazardous waste like paints, dyes, batteries, and human excreta turns hazardous. The recyclables like paper and plastic etc. become unsuitable for recycling as these get soiled by the organic matter.

Although, it would be more fruitful to sort and place different kinds of recyclables in separate receptacles, the waste could be segregated into at least two categories of biodegradable and non-biodegradable initially. The recyclables obtained through segregation could be straightway transported to recycling units which in turn would pay certain amount to the corporations, thereby adding to their income. This would help in formalizing the existing informal set up of recycling units, and this formalization in turn could lead to multi-advantages. The biodegradable matter could be disposed off either by aerobic composting, anaerobic digestion or sanitary land filling. Depending upon land availability and financial resources, either of these disposal methods could be adopted. Though simple land filling is the traditionally practiced system of solid waste management in the planning area, aerobic composting by wind-row method will be an appropriate option. All the nonbiodegradable waste which is non-recyclable, non-reusable shall be dumped into sanitary land fill. Biodegradable waste shall be subjected to composting. Area required for composting shall include the area for storage of unprocessed material, processing facilities for composting operation and storage for green compost.

The area required for windrow composting with 15 days composting period with moisture content between 55-60% for aerobic composting, the first turning shall be done at the 4th day and thereafter every third day shall be 1.5 acres to 2 acres per 50 MT per day waste.

Reuse and Recycling:

The concepts of reuse and recycling can well be applied in solid waste management as solid waste is basically a heterogeneous mixture. In typical Indian municipal solid wastes, there is a small percentage of recyclable material and more of compostable and inert materials like ash and road dust. There is a very large informal sector of rag pickers, who can collect recyclable wastes (paper, plastic, metal, glass, rubber, etc) from the streets, bins and disposal sites for their livelihood. Thus, the rag pickers can be effectively used for the collection of reusable materials especially because the use of non recyclable packaging materials like PET bottles for soft drinks, mineral wastes, and soft -foam products and metalized plastic film coated food packing materials are on the rise. During recycling, many of these release toxic gases and ozone depleting products. So it is advisable to educate people to replace these items with eco-friendly packaging materials. The desirable home sorting mechanisms includes dry recyclable materials (e.g. glass, paper, plastic, cans etc.), kitchen and garden wastes, bulky wastes, hazardous wastes, construction and demolition wastes. Sorting can also be done just prior to waste processing or land filling.

Energy from Solid Waste:

Electricity can be produced by burning MSW as a fuel. MSW power plants, also called waste-to-energy

(WTE) plants, are designed to dispose of MSW and to produce electricity as a byproduct of the incinerator operation. Mass Burn is the most common waste-to-energy technology, in which MSW is combusted directly in much the same way as fossil fuels are used in other direct combustion technologies. Burning MSW converts water to steam to drive a turbine connected to an electricity generator. Burning MSW can generate energy while reducing the volume of waste by up to 90 percent, an environmental benefit. However, this burning MSW in WTE plants produces comparatively high carbon dioxide emissions, a contributor to global climate change. The net climate change impact of these emissions is lessened because a major component of trash is wood, paper and food wastes that would decompose if not burned. If left to decompose in a solid waste landfill, the material produces methane, a potent greenhouse gas. The concept of producing energy from MSW derives significance as it is given high priority by the Ministry of Non-Conventional Energy Sources (MNES), Government of India.

Treatment options:

The biodegradable portion of the waste is considerably high. So, aerobic composting of SW after proper segregation will be more appropriate. In selected locations especially in rural areas, Vermi-Composting can also be recommended. The manure obtained by these methods can be sold to the local public as fertilizer. Though costly, sanitary land filling can also be practiced at selected urban locations where the recovery from the waste will be very high, serving minimum ecological damage. It appears that the aerobic composting by Windrow method may be a desirable option for the management of the solid waste. The possibilities of generating energy from SW could be looked into on an experimental basis.

Biomedical wastes and its management:

Biomedical waste has been a growing concern because of the awareness in public regarding HIV, AIDS and Hepatitis B and exposure to discarded needles, syringes and other medical waste from municipal garbage bins and disposal sites. The management of biomedical waste turns important as it has serious bearing on the quality of human life. This becomes more significant especially in the context of the recent trend of establishing multispecialty hospitals in urban centers. Biomedical waste can be regarded as any waste generated during the diagnosis, treatment or immunization of human beings or animals or produced due to ac tivities of biological research, human anatomical waste, animal waste, microbiology and biotechnology waste, waste sharps, discarded medicines and cytotoxic drugs, solid wastes, liquid waste, incineration ash, chemical waste, etc. Medical wastes contain pathological waste (such as human tissues such as limbs, organs, fetuses, blood and other body fluids), infectious waste (soiled surgical dressing, swab material in contact with persons or animals suffering from infectious diseases, waste from isolation wards, cultures or stocks of infectious agents from laboratory, dialysis equipment, apparatus and disposable gowns, aprons, gloves, towels, etc.), sharps (any item that can cut or puncture such as needles, scalpels, blades, saws, nails, broken glass, etc.), pharmaceutical waste (drugs, vaccines, cytotoxic drugs and chemicals returned from wards, outdated drugs, etc.), chemical waste (any discarded solid, liquid or gaseous chemicals from laboratories, cleaning and disinfection) etc.

Implementation of Bio-medical Wastes (Management and Handling) Rules, 1998

The Ministry of Environment and Forests issued the Bio-medical Wastes (Management and Handling) Rules, 1998 which were amended subsequently. These rules provide for segregation, packaging, transportation, storage, treatment and disposal of wastes generated by hospitals, clinics and laboratories. Bio-medical wastes (BMW) have been classified into various categories and the treatment and disposal options for each of the categories are specified. The treatment and disposal should be in compliance with the standards prescribed in Schedule V, which stipulates standards for incinerators (operating and emission standards), for waste autoclaving, for liquid waste, of microwaving and for deep burial. A schedule for implementation of BMW rules has been laid down in Schedule VI. Imposing segregated practices within hospitals to separate biological and chemical hazardous wastes that will result in a clean solid waste stream, which can be recycled easily. An Advisory Committee is to advise the prescribed authority on the implementation of these Bio-

7.1.4.6 Processing and Disposal of Solid Waste

medical wastes (Management and Handling) Rules.

The solid waste can be processed by composting, vermi-composting, anaerobic digestion, sanitary land filling, incineration or any other biological processing for stabilization of wastes. Since it contains a high amount of biodegradable portion, composting may be a cost-effective option for processing. The process of microbial composting or vermi-composting may be adopted with least mechanization to keep the cost low, and to market the compost as fertilizers to adjoining villages. So the concerned municipalities are duty bound to earmark required acres of land to meet the requirement of solid waste treatment. The areas of existing dumping yards can also be developed. The rejects from these plants and domestic hazardous wastes may be carefully landfilled. The bio-medical wastes may be disposed off as per the Bio-Medical Waste Management and Handling Rules as described above.

A decentralized treatment system will be more feasible option for solid waste treatment. In combination with primary waste collection, composting improves the precarious waste situation in the communities, and residents become less dependent on the poor municipal waste collection service. Decentralized composting can be operated by an appropriate technology and implemented at reduced investment and operating costs. Manual composting in small, decentralized plants is more easily integrated in the prevailing level of development in India and the socio-economic background, as it requires labour-intensive processes. It will create employment opportunities and a source of income to the underprivileged people in the rural Nagaon. Decentralized composting allows reuse of organic waste where it is generated, thereby reducing waste quantities to be transported as well as transport costs. This may drastically reduce the overall cost of

7.1.4.7 Proposals for Solid Waste Treatment

municipal solid waste treatment.

The solid waste generation expected in Nagaon Planning Area by 2045 is very high, providing compost treatment facilities for this huge quantum of wastes, though essential, may not be practically possible in a single phase. So, it is necessary to propose economically feasible and, technically viable solutions which can be implemented in a phased manner. The densely populated urban areas of NMPA are to be given first priority in providing the composting facilities for solid waste treatment. The area required for solid waste

1.7.4.8 Disposal of Hazardous Waste

treatment and disposal facilities will be 8 hectares.

The Notification from the Government of India, Ministry of Environment dated 20th July 1998, which deals with the collection of Bio-Medical Wastes entrusts the liability of its disposal with the waste producer itself. Thus the management of bio-medical waste is not the responsibility of Municipalities. But, however, they can assist in the management of biomedical wastes on a full cost recovery basis without sharing any legal responsibilities. It is advisable to have bio-medical facility for the entire Nagaon Planning Area. The bio-medical wastes collected from spots can be stored in selective transfer stations and can be transported to this central treatment facility at village Kachamarigaon Western side of planning area. If so desired, the authorities can formulate an action plan for implementing this plant through some competent agencies and can suitably charge for the treatment and disposal of bio-medical wastes. The solid waste dumping sites closest to industrial sites will be a more appropriate option.

7.1.5 ELECTRIC ENERGY

7.1.5.1 Power Grid of Nagaon Master plan Area

The present power demand of the city including that of the three regions of Nagaon, area is 35.42 MW. At present there is no shortage in meeting the requirements of the present demand in any of the region. Present electricity demand of Nagaon city and its adjoining small villages mentioned in the table below.

Table 168: Annual or Monthly Supply of Power of Nagaon

Type of Consumer	Demand (mw)	Supply (mw)
Residential	29.12	29.12
Government	1.82	1.82
Social and Institutional	1.92	1.92
Commercial	1.66	1.66
Industrial	0.40	0.40
Agriculture	0.50	0.50

(Source: APDCL, Nagaon)

Table 169 Demand and Supply of Power

Sr. No.	Particulars	Details
1	Demand for energy	35.42 MW Peak Demand
2	Annually or monthly supply of power	Average 7 MU per Month
3	Numbers of metered connections	111344 Nos

(Source: APDCL, Nagaon)

7.1.5.2 Power Supply Demand Projection

The present power demand is 35.42 MW. The power demand for 2045 is calculated by assuming 2.74 kWh per capita per day considering domestic, commercial, industrial and other requirements as per URDPFI guidelines 2015. The power demand for the 2045 will be 127.2 MW.

Table 170: Power Demand for 2045

Sr. No.	Particulars	Demand		
		2021	2031	2045
1	Projected Population	346140	392696	464221
2	Power Requirement @2.74 kWh per capita per day	94.84 MW	107.59 MW	127.2 MW

(Source: Compiled by Consultant)

Power demand – 2.74 kWh per capita per day considering domestic, commercial, industrial, and other requirements as per URDPFI guidelines 2015

As per the population 2021 for Nagaon Master Plan Area, the Power Demand is 94.84 MW considering 2.74 kwh per capita per day. The Power Requirement for 2045 will be 127.2 MW. Even if the possibility of use renewable energy is to be explored and promoted. The strategies are proposed below:

7.1.5.3 Proposed Strategies

- There are various other sources, such as Wind energy and solar energy for generating power which is required to be explored.
- Additional solar energy to be sold to public grid/ electricity authority.
- Sector-wise power demand needs should be worked out which will be helpful in proper planning & estimating future power requirement.
- Incorporation of Renewal Power Obligations (RPO) in building byelaws (applicable to major building projects >20,000 sq.ft.)
- Tax concession on material and appliances procured for renewable energy products.

7.2 SOCIAL INFRASTRUCTURE

Social infrastructure plays an important role to provide quality of life to the residents of the city. The effectiveness of social infrastructure in achieving the objective of city development plan would depend upon its capacity to contribute to improvement in the quality of life, enhanced self-dependency and city's sustainability. The level of social infrastructure shall aim the creation of liveable city through reducing the sense of alienation among the residents with less dependence on other settlements for basic infrastructure.

Social infrastructure refers to the facilities and mechanisms that ensure education, health care, community development, and social security, recreational and social welfare. The development cannot be looked at in isolation without considering the basic needs of the people, and a significant level of investment is needed in this sector. Usually this development referred to as the commitment towards realizing the visionof the city.

7.2.1 EDUCATION

Education is an important factor influencing the quality of life of the people and future development of an area. It empowers them with skills and knowledge and helps them to better lead their life and to access best of the employment opportunities available in the market. This in turn will impact the work force participation rate and economy of the area.

7.2.1.1 Educational Facilities in Pre-Primary & Secondary Education

There are many government and private schools, colleges in Nagaon city town and District.

The existing scenario of Primary, Middle school and Higher secondary school for the Nagaon area is shown in the table given below:

Table 171: No. of Pre-primary Schools to Secondary Schools of Nagaon Master Plan Area

Sl. No.	Category of Education Institutions	Total No. of Institutions	Enrolment	Teachers
1	Lower Primary School's	86	9503	692
2	M.E & M.V School	20	3399	216
	Total	106 Nos.	12902	908

(Source: Inspector of Schools, Elementary and Higher education)

Nowgong College

Dawson school, Nagaon